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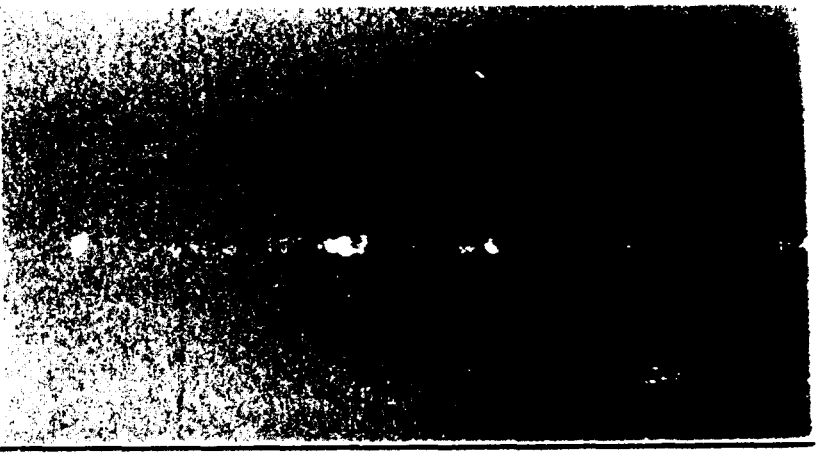
Assessment
for

OLIN CORPORATION/MCINTOSH PLANT
MCINTOSH, WASHINGTON COUNTY, ALABAMA
CERCLIS NO. ALD008188708
MARCH 3, 1994



PUBLIC HEALTH ASSESSMENT

OLIN CORPORATION/MCINTOSH PLANT

MCINTOSH, WASHINGTON COUNTY, ALABAMA

CERCLIS NO. ALD008188708

Prepared by

Alabama Department of Public Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations 42 C.F.R. Part 90). In preparing this document ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30 day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

Additional copies of this report are available from:
National Technical Information Service, Springfield, Virginia
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ATSDR and its Public Health Assessment

ATSDR is the Agency for Toxic Substances and Disease Registry, a federal public health agency. ATSDR is part of the Public Health Service in the U.S. Department of Health and Human Services. ATSDR is not a regulatory agency. Created by Superfund legislation in 1980, ATSDR's mission is to prevent or mitigate adverse human health effects and diminished quality of life resulting from exposure to hazardous substances in the environment.

The Superfund legislation directs ATSDR to undertake actions related to public health. One of these actions is to prepare public health assessments for all sites on or proposed for the Environmental Protection Agency's National Priorities List, including sites owned or operated by the federal government.

During ATSDR assessment process the author reviews available information on

- the levels (or concentrations) of the contaminants,
- how people are or might be exposed to the contaminants, and
- how exposure to the contaminants might affect people's health

to decide whether working or living nearby might affect peoples' health, and whether there are physical dangers to people, such as abandoned mine shafts, unsafe buildings, or other hazards.

Four types of information are used in an ATSDR assessment.

1) environmental data; information on the contaminants and how people could come in contact with them

2) demographic data; information on the ethnicity, socioeconomic status, age, and gender of people living around the site,

3) community health concerns; reports from the public about how the site affects their health or quality of life

4) health data; information on community-wide rates of illness, disease, and death compared with national and state rates

The sources of this information include the Environmental Protection Agency (EPA) and other federal agencies, state, and local environmental and health agencies, other institutions, organizations, or individuals, and people living around and working at the site and their representatives.

ATSDR health assessors visit the site to see what it is like, how it is used, whether people can walk onto the site, and who lives around the site. Throughout the assessment process, ATSDR health assessors meet with people working at and living around the site to discuss with them their health concerns or symptoms.

A team of ATSDR staff recommend actions based on the information available that will protect the health of the people living around the site. When actions are recommended, ATSDR works with other federal and state agencies to carry out those actions.

A public health action plan is part of the assessment. This plan describes the actions ATSDR and others will take at and around the site to prevent or stop exposure to site contaminants that could harm peoples' health. ATSDR may recommend public health actions that include these:

- restricting access to the site,
- monitoring,
- surveillance, registries, or health studies,
- environmental health education, and
- applied substance-specific research.

ATSDR shares its initial release of the assessment with EPA, other federal departments and agencies, and the state health department to ensure that it is clear, complete, and accurate. After addressing the comments on that release, ATSDR releases the assessment to the general public. ATSDR notifies the public through the media that the assessment is available at nearby libraries, the city hall, or another convenient place. Based on comments from the public, ATSDR may revise the assessment. ATSDR then releases the final assessment. That release includes in an appendix ATSDR's written response to the public's comments.

If conditions change at the site, or if new information or data become available after the assessment is completed, ATSDR will review the new information and determine what, if any, other public health action is needed.

For more information about ATSDR's assessment process and related programs please write to:

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Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry
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Atlanta, Georgia 30333

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SUMMARY

The Olin Chemicals/McIntosh Plant (Olin) National Priorities List (NPL) site is an active industrial facility in McIntosh, Washington County, Alabama. Olin currently owns the site. Development of the site began in 1951 with the construction of a mercury cell chlor-alkali production plant. Presently, Olin produces chlorine, caustic soda, sodium hypochlorite and sodium chloride on the site.

Mercury, DDT, hexachlorobenzene, chloroform and 1,2,2,2-tetrachloroethane are the main contaminants of concern found on and off the site. On-site groundwater, subsurface soils, sediments and fish are contaminated. Some contaminants of concern were found in off-site domestic water wells. About 250 people live in McIntosh and more live in the surrounding area. People who live in the community are concerned about possible exposure to contaminated water, air and soil. They are worried that fish, game and vegetables from home gardens may be contaminated. We found that eating fish caught in the basin and drinking water from four contaminated wells are completed human exposure pathways for some contaminants of concern. People who eat fish from the basin are at risk for central nervous system, chromosome and kidney damage from DDT and mercury exposure. Unborn children may suffer the most serious effects since mercury exposure can cause brain damage and learning deficits in fetuses. Over a lifetime of exposure, eating fish from the basin and drinking water from the contaminated wells may result in an increased risk for cancer.

We classified the site as a public health hazard based on the available data. The data suggest that some people may have been exposed to levels of toxic chemicals that can cause adverse health effects. Data are inadequate or unavailable for some environmental media. The limited health outcome data available do not show that the site has had an adverse impact on the health of the surrounding population.

Additional sampling and monitoring of ambient air, groundwater, on-site and off-site surface soils and fish from the basin are necessary to describe and track the extent of contamination at the site. Public access to the basin (OU-2) area should be further restricted. The Alabama Department of Public Health (ADPH) advises limiting consumption of fish caught in the basin.

The ATSDR Health Activities Recommendation Panel has recommended that a survey of basin fish consumption rates be performed to further define the exposed population, and that the exposed population should be educated about possible health effects from eating mercury and DDT contaminated fish from the basin.

The ADPH will provide educational materials to a local physician and will be available to answer questions from the community pertaining to the site. The ADPH will evaluate the feasibility of conducting quarterly testing on the mercury contaminated well, and of conducting a fish consumption survey. ATSDR will evaluate the feasibility of a community education program designed to acquaint the community with the possible health effects from eating mercury and DDT contaminated fish.

BACKGROUND

The Alabama Department of Public Health (ADPH), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR) will evaluate the public health significance of Olin. ATSDR, located in Atlanta, Georgia, is a federal agency within the United States Department of Health and Human Services. The agency is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to conduct public health assessments at hazardous waste sites. ADPH and ATSDR will judge whether the site can cause harmful health effects and, if so, will recommend actions to reduce or prevent such effects.

A. Site Description and History

The Olin Chemicals/McIntosh Plant (Olin) National Priorities List (NPL) site is located on Industrial Road about one mile east-southeast of McIntosh in Washington County, Alabama (Figure 1, Appendix A). Ciba-Geigy Corporation, also an NPL site, adjoins Olin property to the north (Figure 2, Appendix A). The Tombigbee River borders Olin to the east. Clarke County lies across the river. River Road separates the site from a residential area to the south. U.S. Highway 43 serves as the western boundary, although Olin owns some additional property west of the highway.

Olin consists of about 1500 acres. The general terrain is flat but slopes upward to the north and west. The eastern section of the Olin property is on the Tombigbee River floodplain. Bilbo Creek and Birch Branch converge near the northwestern border of the site, and flow into a swampy area on the extreme western edge. Two wet weather creeks flow from the northern into the eastern end of the site.[1]

The site is divided into two sections, called Operable Units 1 and 2 (OU-1 and OU-2) (Figure 3, Appendix A). OU-1 includes most of the total area owned by Olin, including the active plant site and the upland area of the property. OU-2 is a 65-acre region located near the Tombigbee River and connected to the river by a waterway.[1]

The active production plant in OU-1 covers about 60 acres. It is flat and about 40 to 50 feet above mean sea level. The rest of OU-1 is undeveloped except for the brine well field to the west. An 8 feet high chain-link fence encloses the entire OU-1 section of the site. Approximately 4,000 feet east of the main plant area is a steep bluff, running north to south, which marks the edge of the OU-2 floodplain area.[1]

OU-2 is a 65 acre basin located on the Tombigbee River floodplain. The basin is a natural oxbow lake. An oxbow lake occurs when a river cuts a new channel and a former river bend becomes a lake. These lakes typically have a bow shape, hence the name. The basin floods during the high water season, approximately four to six months of the year. It becomes contiguous with the Tombigbee River during the flood season, making entry from the river possible. Plant wastewater was discharged into the basin from 1952 until 1974.[1]

Olin currently owns the land on which the site is located. Initial site development began in 1951 when Mathieson Alabama Chemical Corporation constructed the mercury cell chlor-alkali production plant. This company was owned by Mathieson Corporation which, in time, became Olin. The mercury cell plant manufactured chlorine and caustic soda. Calabama Chemical Company constructed the organics chemical plant in 1952 on property bordering the mercury cell plant. Olin acquired the chemical organics plant in 1954. Originally, the plant produced monochlorobenzene. Production of pentachloronitrobenzene (PCNB) began in 1956 with the completion of the PCNB plant. The organics plant expanded in 1973 to manufacture trichloroactonitrile (TCAN) and 5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole (trademark Terrazole). This part of the production area is called the Crop Protection Chemicals (CPC) plant.[1]

In 1982, the CPC and mercury cell plants were closed. Under a plan approved by the Alabama Department of Environmental Management (ADEM), the CPC plant was demolished and the site was capped. The chlorine plant was closed and dismantled between 1982 and 1986.[1]

Olin constructed a diaphragm cell caustic soda/chlorine plant in 1977 that is still in operation. Presently, Olin produces chlorine, caustic soda, sodium hypochlorite, and sodium chloride. The plant also blends and stores hydrazine compounds.[1]

Olin mines a salt dome in the western area of the site through nine brine production wells (Figure 3, Appendix A). The mercury cell plant used the first 6 wells. These wells have been closed. Three remaining wells are used by the diaphragm cell plant. Olin has developed 2 additional cavities for non-production related uses. Alabama Electric Cooperative uses 1 cavity to store high pressure air for off-peak power production. Baygas Incorporated stores natural gas in the most recently developed well.[1]

Olin was placed under the Resource Conservation and Recovery Act (RCRA) in 1980. Before this, Olin had begun a groundwater investigation program. In 1981-82, ADEM requested expansion of the groundwater investigation. During this period, Olin began installing monitoring wells to discover the extent of on-site groundwater contamination. Twelve wells were installed to detect hazardous substance releases to comply with RCRA regulations. Chlorinated organic compounds and mercury were found in the groundwater during the investigation.[1]

As part of a further investigation into groundwater contamination, Olin installed 32 additional on-site wells in 1982. That study showed two plumes of contaminants in the Alluvial Aquifer, moving west-southwest and east-southeast. Contaminants in the plumes were mostly benzene, chloroform, chlorobenzene, and dichlorobenzene. Olin installed 14 additional wells in 1983 to help define the plumes. Ten more monitoring wells have been installed since 1984. Construction on the five well system for the groundwater corrective action program (CAP) began operation in 1987.[1]

An Environmental Protection Agency (EPA) contractor inspected Olin in 1982 and 1983. Based on that inspection, a Hazardous Ranking System assignment was made. In September 1984, the site was placed at position number 320 on the National Priority List (NPL) for clean up. The position was later changed to number 505. Olin closed or clean-closed 10 Solid Waste Management Units (SWMU) at the McIntosh site between 1984 and 1985. Clean-closed means that a site or feature has been cleaned up to standards set by the Resource Conservation and Recovery Act (RCRA), and is no longer considered hazardous. In 1988, four of the six mercury cell brine wells were shut down. Two other brine wells used by the closed mercury cell plant were shut down in 1972 and 1985. The cavities contain brine with low concentrations of mercury. The EPA and/or ADEM reviewed and approved the closures.[1]

The EPA and Olin reached agreement in 1989 that the data collected as part of compliance activities for RCRA was to be incorporated into a CERCLA Remedial Investigation (RI). This information also was used to produce a Risk Assessment (RA) of Olin. Olin developed the scope of work for the RI/RA, and the EPA approved it in 1990 as part of an administrative consent order. A work plan was developed under jurisdiction of the consent order, and an amended version of it was approved by the EPA in July 1991.[1]

The amended Remedial Investigation/Feasibility Study work plan (RI/FS) identified 17 SWMUs. An EPA conducted RCRA Facility Assessment (RFA) listed 52 SWMUs, including the 17 already identified, and 6 areas of concern (AOC). The RFA recommended work at 17 SWMUs and the 6 AOC. Recommendations ranged from including additional documentation on some SWMU's and AOC, to conducting RCRA Facility Investigations (RFIs). The RFA recommended sampling at the following SWMUs/AOC: the Crop Protection Chemicals (CPC) Plant, the Old Plant (CPC) Landfill Drainage Ditch, the Mercury Cell Plant, the Well Sand Residue Area and the Strong Brine Pond (Figure 3, Appendix A).[2]

Olin conducted a baseline human health assess...ent to determine potential resident/trespasser and worker exposure to chemicals of concern. The report identified two completed exposure pathways for the residential population: 1) domestic well water consumption, and 2) ingestion of fish from the basin (OU-2). The assessment identified two other potential exposure pathways: 1) contact with surface water in the basin, and 2) contact with soil and sediments in OU-1 and OU-2. Estimates of lifetime cancer risk for residents/trespassers was low. More than 90 percent of the excess risk was associated with consumption of fish from the basin.[1]

The Draft Remedial Investigation[1] (RI) identified sampling of groundwater monitoring wells as an exposure pathway for Olin workers. However, the risk was considered minimal.

Geology

Alternating beds of sedimentary rocks underlie Olin to a depth of several hundred feet. The rocks dip to the southwest. Sediments near the surface consist of beds of sand, gravel, silt

and clay, either alone or in various combinations. Permeable sand and gravel units in these deposits are aquifers, or naturally occurring underground water containing units. The Alluvial Aquifer is located directly underneath Olin and the surrounding area, and is the water source for domestic wells. Depth of the aquifer varies from 50 to 80 feet. The Miocene Aquifer underlies the Alluvial Aquifer and is made up of alternating layers of water bearing units and confining units. Confining units are layers that are relatively impermeable and so may prevent migration from the water bearing units to other aquifers. The Miocene Aquifer ranges in depth from 275 feet to more than 600 feet. It is the industrial water source for Olin and the nearby Ciba-Geigy facility. Wells drilled into the Miocene Aquifer provide water for the local municipal water system, also.[1]

B. Site Visit

ADEM Environmental Engineer, Christopher Johnson and ADPH Epidemiologist, Janice Gilliland visited Olin on June 30, 1993. The team inspected the site, accompanied by personnel from Olin. The visit consisted of a drive through survey of the OU-1 and OU-2 areas.

An 8 feet high chain-link fence encloses OU-1. The fence effectively prevents trespass into the working area. One corrective action well was temporarily shut-down for maintenance at the time of the visit.

River Road separates Olin from a residential area (see Figure 2, Appendix A). The site of the Old CPC plant, possibly the source of on-site groundwater contamination,[1] is approximately 200 feet from the private residences across the road. The main Olin production area is approximately one-fourth mile from the nearest house across River Road.

The OU-2 area is not fenced. Barred gates across roads and trails leading into the OU-2 part of the site prevent vehicles from entering, but these gates do not block pedestrian entry. In addition, Olin relies on a discharge ditch and "No Trespassing" signs to deter entrance to the OU-2 area. A weir across the discharge ditch at the entrance of the basin is designed to prevent access from the river except during flood stage. Pedestrians can enter the basin during the dry season by crossing a drainage ditch.

A fish camp is located on the west bank of the Tombigbee River near the OU-2 area (Figure 2, Appendix A). Houses in the fish camp get water from the municipal well system. ADPH Environmental Toxicologist, Brian Hughes and Epidemiologist, Janice Gilliland visited the camp on April 23, 1993. At the visit, several families were in residence. A sign near the entrance to the camp stated "Fish for Sale." A short walk through the woods brings one to the fordable wastewater ditch that separates the camp from Olin property. Hunters, fishers and adolescent children have access to lands and surface waters on the Olin property by this means of ingress. We do not know if children cross the wastewater ditch and enter Olin property, but surveys of local residents found that people fish in the basin.[1,5]

C. Demographics, Land Use, and Natural Resource Use

Demographics

According to 1990 census data,[3] the population of Washington County is 16,694 people. It is 66% white, 28% black and 6% American Indian, with fewer than 1% of all other races. The population is 51% female. Three percent of the population is under five years old and 12% are age 65 years or older.

The population in McIntosh and the surrounding area apparently is quite stable, with little in- or out-migration. The town of McIntosh has 250 residents, making up 91 households. Fifty-one percent of the inhabitants are male. The population is 83% white and 16% black. About 8% are under 5 years of age and 31% are 20 years old or younger. The 60 years and older group comprises 16% of the total population. Median age is 34.4 years. Young children and the elderly are potentially vulnerable populations because of their increased sensitivity to toxic substances.

A geographic information computer software program called Atlas GIS[4] was used to estimate population within a one mile radius of Olin. The program bases estimates of populations on the percentage of block groups contained within the specified radius, and thus is only an approximation of the actual population in the defined area. Atlas GIS gives an estimated population of 134 people living in 40 households within a one mile radius of Olin.

There are three schools in or near McIntosh; two public elementary schools, a public high school, and a small private school that has an enrollment of 30 students in grades kindergarten through 12. Total public school enrollment for the 1992-1993 academic year was 806 students (Telephone communication with the secretary to the Superintendent, Washington County Board of Education, July 1993). Students are drawn from McIntosh and from the surrounding countryside. McIntosh High School, with an enrollment of 305 students in grades 7 through 12, is encircled by Olin property. The school is south-southeast of the brine well field (Figure 2, Appendix A).

Land Use

The area around Olin is primarily rural, with some mixed land use. Local commercial and industrial activity are concentrated on U.S. Highway 43. Olin and the Ciba-Geigy Corporation are the two major industries and primary employers in the area. Other industries include the Alabama Electric Cooperative Compressed Air and Energy Storage facility across from McIntosh High School, and the C & B Cement Company about three miles south of McIntosh.[5]

Commercial activity in and around McIntosh is chiefly limited to providing essential goods and services. Public land use areas include the town government buildings, the post office, public schools, a public library, churches, and cemeteries.[5]

Single family houses make up most of the residential section of the town. Many dwellings are small and of poor quality. Mobile homes are common. Most residential areas have from two to twenty houses.[5] During the site visit, we observed that some households have family gardens, and less commonly, some keep chickens and other livestock.

Natural Resource Use

Water for industrial and domestic uses is provided by the two main aquifers underneath Olin and surrounding area. Domestic well water is drawn from the Alluvial Aquifer. Municipal water comes from wells sunk into the Miocene Aquifer. The McIntosh municipal wells are approximately three-fourths mile west of Olin. Industrial water is drawn from the Miocene Aquifer, also.[1]

In 1991, a survey of domestic well users in a 3 mile radius of Olin was conducted.[5] The survey results reported a total of 122 domestic wells. The number of households with wells is greater than 122 because two or more households sometimes share a single well. Forty-three of the wells were actively in use. Thirty-four of the 43 active wells provide drinking water for one or more households. Two of the remaining 79 wells are inactive. The rest are closed or unable to supply water for various reasons, including lack of a pump. Inactive wells are those wells able to supply water, but not in use at the time of the survey. Most of the active wells are on the outskirts of McIntosh, mainly south and southeast of town. Active wells are used for drinking and other domestic purposes, such as watering home vegetable gardens and livestock.

The Tombigbee River is the major surface water body in the area. Several smaller streams flow into the river, including Bilbo Creek that drains the Olin property. Oxbow lakes are common, as are other wetlands. Water resources are used for recreation, transportation, and to supplement food sources. The surface water and wetlands are important bird and wildlife habitats.

Commercially important resources in Washington County include petroleum, natural gas, salt, sand and gravel. Shortleaf pine, slash pine and hardwood timbers are important plant resources.[6] Much of the area surrounding Olin is upland forest, defined as forested land higher than 15 feet above sea level. Private and commercial timber companies own much of the forested land. Periodic clear-cutting of forests exposes large sections to regrowth, mainly by pine trees. Included in the upland forests are game plots and areas cleared for pipelines and electrical lines.[5]

There are two public use recreational areas near Olin; the town park located just off River Road, and the fishing camp on the Tombigbee River bluff at McIntosh Landing. Fishing is popular in the area and fish catches are sources of food. Most open water areas are used for fishing, boating, swimming and water skiing. Hunting game plots are scattered through the upland forest area. Hunting is an additional food source.[5]

D. Health Outcome Data

The State of Alabama does not maintain a cancer registry, but the ADPH compiles an annual report on cancer mortality rates.[7] Rates are published by state and by county. In addition, the ADPH conducted a cancer mortality study in 1990 for McIntosh and Washington County to address concerns about a possible increase in cancer rates for the area.[8] The report covered an 8 year period from 1980 to 1988. This report will be discussed in the section on Public Health Implications, Health Outcome Data Evaluation.

The ADPH maintains a database on infant mortality, and reports statistics annually.[7] Mortality rates are listed for the state and for each county, but not for municipalities.

COMMUNITY HEALTH CONCERNS

Persons living in McIntosh or the surrounding area voiced several health concerns regarding exposure to contaminants from local industries. People voiced these concerns at the Public Availability Meeting (PAM) held February 4, 1993, and by mail and telephone. These concerns will be addressed in the Public Health Implications, Community Health Concerns Evaluation section.

Air Exposure Health Concerns

1. Some McIntosh residents and former plant workers are concerned about air pollution and airborne contaminants that may have caused the breathing and lung problems from which they now suffer. Some citizens believe the area has a higher than normal rate of respiratory problems.

2. McIntosh residents are worried that the prevailing winds blow air contaminants downwind from the Olin and Ciba-Geigy plants, causing corrosion of aluminum doors, windows and propane tanks.

Ingestion Exposure Concerns

1. Residents are concerned that fish and wildlife may be contaminated.

2. The possible contamination of vegetable gardens is a concern.

3. Several people have concerns about drinking water supplies. Some residents complain about odors in the water. It is unclear if complaints refer to the municipal water supply or to domestic well water.

Other Health Concerns

1. Residents are concerned about possible health consequences to children who play in contaminated soil.

2. McIntosh residents express concern that the community shows high rates of several diseases, including cancer, diabetes, strokes, and high blood pressure. Other complaints include stomach cramps and stomach problems, diarrhea, low resistance to colds, flu and other diseases, chronic bronchitis and recurring infections. Headaches are commonly mentioned as a health concern. Two people have complained of the loss of sense of smell; one of these has lost her sense of taste as well.

3. The local physician has reported that several families in the area have members with multiple sclerosis.

The Olin Chemicals/McIntosh Plant site public health assessment was available for public comment from December 6, 1993 to January 15, 1994. The public health assessment was available to community residents and other interested parties at the McIntosh Town Hall and the Saraland Public Library. News releases and legal notices announcing the public comment period appeared in local newspapers. The public comment period was intended to give community members and other interested parties an opportunity to voice additional concerns or make comments pertaining to the Olin Chemicals/McIntosh Plant site public health assessment. However, no comments were received by the Alabama Department of Public Health during the comment period (Appendix D).

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

This section is a review of the environmental data collected at Olin and an assessment of the quality of the data. This section also deals with on-site contaminants of concern and the frequency and concentration in various media of these contaminants. On-site contamination will be reviewed first, followed by off-site contamination. On-site is the area within the confines of Olin property, including Operable Unit-1 (OU-1) and Operable Unit-2 (OU-2). Off-site is any location outside the boundaries of Olin property within a 3 mile radius of the plant. We selected the 3 mile radius limit because this was the area covered in the domestic well survey.

A review of the sampling data reported in the Draft Remedial Investigation Report for Olin found the following on-site contaminants of concern:

Selected Metals

Arsenic	Beryllium
Lead	Mercury

Volatile Organic Compounds
Chloroform

Semi-Volatile Organic Compounds
1,3-Dichlorobenzene 1,4-Dichlorobenzene
Hexachlorobenzene

Pesticides
p,p'-Dichlorodiphenyltrichloroethane (DDT)

The basis for selection of these contaminants are as follows:

1. concentrations of contaminants on site above ATSDR or EPA comparison values;

2. concentrations of contaminants for which no comparison values could be found;

3. the sampling design and field and laboratory data quality; and

4. community health concerns.

Including a chemical in the list of contaminants of concern does not mean that adverse health effects necessarily will result from exposure. Identification of all contaminants assures that each one will be included in the public health assessment to be evaluated further as to its health impact on the local population.

The only off-site sampling conducted was of domestic well water from private wells. The following contaminants of concern with values equal to or above comparison values, or for which no comparison value exists, were detected:

Chloroform
Mercury
1,1,2,2-Tetrachloroethane

These contaminants will be discussed in the section dealing with the domestic well water medium of transport. Contamination by other media also are discussed in the sections that follow.

Toxic Chemical Release Inventory

A search of the EPA Toxic Chemical Release Inventory (TRI) for information on Olin showed non-point or point releases of chlorine, hydrochloric acid, sodium hydroxide

(solution), asbestos (friable), sulfuric acid, 1,1-dimethyl hydrazine and hydrazine in varying amounts.

The TRI database search showed releases in 1991 of environmental contaminants from one other industry in McIntosh, the Ciba-Geigy facility that adjoins Olin to the north. However, none of the chemicals listed corresponded with the contaminants of concern found on Olin.

A. On-Site Contamination

The tables presented in Appendix B list the contaminants of concern in various on-site and off-site media. The contaminants of concern are evaluated in later sections to decide if exposure has public health significance. The data tables and text include the following abbreviations:

- **CREG** Cancer Risk Evaluation Guide
- **EMEG** Environmental Media Evaluation Guide
- **MCL** Maximum Contaminant Level
- **MRL** Minimal Risk Levels
- **ppm/ppb** parts per million/parts per billion
- **RfD** Reference Dose
- **RMEG** Reference Dose Media Evaluation Guide
- **TAL** Target Analyte List constituents

In preparing a public health assessment, contaminant concentrations in specific transport media are compared to established comparison values to select specific contaminants of concern for further study. No comparison values exist for some constituents and the tables reflect this situation. The most commonly used comparison values are ATSDR's Environmental Media Evaluation Guides (EMEGs) and Cancer Risk Evaluation Guides (CREGs), although other values may be used as necessary. CREGs are estimated contaminant concentrations based on one excess cancer case per million persons exposed over a lifetime, and are calculated from the EPA's cancer slope factors. An EMEG is the amount of a particular contaminant that can be present in a specific medium below which no known non-cancer effects are expected to result from exposure. The estimates are derived from ATSDR's MRLs.

When EMEGs and CREGs are not available, RMEGs are used. An RMEG is the estimated intake of a media specific contaminant below which no known non-cancerous health effects

are likely to occur. An RMEG is calculated from the EPA RfD. The RfD is the daily acceptable intake level at or below which no non-cancerous health effects are expected from exposure.

On-Site Groundwater

Figure 4 (Appendix A) shows the location of the on-site monitor, process and corrective action wells. Results from 27 samples from the Alluvial Aquifer are included in the draft RI for Olin.[1] Table 1 (Appendix B) lists the contaminants of concern found in this aquifer during on-site testing. The on-site groundwater contains measurable amounts of 13 metals, 10 volatile organic compounds (VC)s), 6 semi-volatile organic compounds and 5 pesticide chemicals of concern. All the chemicals of concern listed in Table 1 were detected in the analyses, although no one constituent was found in all samples. Lead and zinc are the most frequently reported constituents, found in 24 of the 27 samples. Bervllium and mercury are the next most common (18 of 27). Antimony, Selenium, 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, carbon tetrachloride, phenol and gamma-chlordane are found in one sample each.[2] No volatile organic compounds (VOCs) or semi-volatile organic compounds or pesticides/polychlorinated biphenyls (PCBs) are present at detectable levels in the comparison background well (WP9A). Background levels for inorganic constituents are estimated, undetected, or are below the maximum levels reported for on-site groundwater samples.

No constituents above drinking water MCL standards were found in samples from the two municipal wells and the on-site wells drawing from the Miocene Aquifer.[1]

On-Site Surface Water

During August 1991, 13 surface water samples were taken at randomly selected locations in the discharge ditch, the wastewater ditch and the basin. All sampled locations are in the OU 2 section of the site. The samples were analyzed for VOCs, semi-volatile organic compounds, pesticides/PCBs and selected metals. Figure 5 (Appendix A) shows the geography of OU-2 and the location of surface water samples. The maximum concentrations of contaminants of concern in surface water are presented in Table 2 (Appendix B). The contaminants of concern in on-site surface water are limited to arsenic, chromium, lead and mercury. Arsenic and chromium are present at levels above comparison values.

Shallow Soils

Surface soil contaminants from Olin are largely undetermined. Only on-site features were sampled; off-site surface soils were not sampled. No samples were taken from the 0 to 3 inch depth. Of a total of 43 soil samples taken from specific, suspect OU-1 features, only two were surface or near surface samples. A sample from the Well Sand Residue area, taken at a depth of 0-6 inches, was analyzed for mercury only. The sample had a mercury concentration of 20.10 ppm. Another sample was taken from the Old Plant Drainage Ditch at

a depth of 0-12 inches (characterized in this report as shallow soil). Table 3 (Appendix B) shows the results of the drainage ditch sample. Arsenic and hexachlorobenzene are present in amounts greater than the ATSDR comparison values.

Sediments

Sediments in OU-2 were sampled in three phases, beginning in August 1991. Fifteen core samples--5 at each of 3 locations--and 112 grab surface (0-6 inches) samples were taken from the basin and ditches during Phase I testing (Figure 5, Appendix A). Two core samples were taken at the locations with the highest concentrations of mercury in the 1987 investigation. The remaining core sample was taken from the former discharge ditch at the location of the highest 1987 concentration of hexachlorobenzene. To systematize the sample collection process, a grid pattern was set up in the basin and ditches, and sediment grab samples were collected at approximately 200 feet intervals.[1]

Analyses of Phase I sampling indicated that the dominant organic constituents in OU-2 sediments were semi-volatile compounds. Volatile compounds were more apt to be detected in the deeper core samples.[1] Because there is little likelihood of human exposure to on-site deep sediment soils, only the results from the grab samples are presented in this report.

Phase II sampling was conducted in November 1991 (Figure 5, Appendix A). Additional core samples were taken at locations suggested by the results of Phase I sampling. No grab samples were taken at this time.[1]

Phase III sampling was designed to define the horizontal and vertical extent of constituent contamination and to obtain a background sample for metal constituents. Forty-five grab samples were taken on-site; 40 within the basin floodplain and five in the outfall ditch (Figure 6, Appendix A). One grab sample was taken from the Tombigbee River. A core sample was taken from the wastewater ditch. Phase III grab sediment samples were analyzed for mercury and hexachlorobenzene only. Table 4 (Appendix B) shows the contaminants of concern found in on-site sediments.

Samples from Hatchetigbee Lake were taken to compare to samples from the basin. The sample from the Tombigbee River was for the same purpose. In all cases, the values found in the lake and river samples were below the maximum concentrations found in sediments in the basin floodplain and other areas in OU-2.

Fish

Largemouth bass and channel catfish were collected from the basin during November 1991. Two samples of each species (one whole body and one fillet) were sent to the EPA Oversight Contractor for independent analyses. Ten whole body and 10 fillet samples from each species were sent to Hazelton Environmental Services, Madison, Wisconsin for analysis of chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-

trichlorobenzene, pentachlorobenzene, hexachlorobenzene, pentachloronitrobenzene, 4,4'-DDD, 4,4'-DDE and 4,4'-DDT. Hazelton Laboratory prepared aliquots of the fish samples and sent them to Olin's Charleston, Tennessee laboratory for analysis of total mercury. A rinsate blank from the stainless steel knives used in fish process was submitted to the Olin laboratory.[1] Table 5 (Appendix B) shows the maximum concentrations in fish from the basin area. Analyses showed DDT (plus its breakdown products DDD and DDE), mercury and hexachlorobenzene contaminants in the fish.

B. Off-site Contamination

At this time, verifiable off-site contamination appears to be limited to groundwater in the Alluvial Aquifer. Although fish are consumed off-site, they originate on the site, and thus are included in the discussion of on-site contaminants.

Domestic Well Water

All of the 43 active wells within a 3 mile radius of Olin were tested. Chloroform was found in two wells in concentrations higher than established comparison values (Table 6, Appendix B). One well is located southeast of the main plant facility, at a distance of about three-fourths mile. The second chloroform contaminated water well is approximately one mile southwest of the main plant near U.S. Highway 43. 1,1,2,2-Tetrachloroethane was found in a well located near the second chloroform well but on the southwestern side of Highway 43. One well, less than a mile south of Olin, had low levels of mercury contamination.

Other Off-site Media

No data are available on ambient air or surface soil on-site except for specific features, and no data on off-site air and soils are given in the Remedial Investigation (RI) or Feasibility Study (FS).

C. Quality Assurance and Quality Control

No EPA Quality Assurance/Quality Control (QA/QC) summary for Olin is available. Sampling and analyses procedures were reported in the Draft Remedial Investigation Report.[1] According to Cheryl Smith, EPA's Remedial Project Manager for Olin, the field data, sampling procedures and laboratory analyses met EPA requirements (telephone communication, May 1993). Therefore, in compiling this report, we assumed that adequate QA/QC controls have been followed. The accuracy and completeness of this report are dependent on the adequacy and reliability of the results presented in the previous site reports.

One omission in data quality was noted; not all sample results reported on whether the sample was analyzed for organic or inorganic mercury. The two types of mercury can have different effects making it important to differentiate between them.

When evaluating the adequacy of the data in the sections on on-site and off-site contamination, we assumed that estimated (J) values are valid. We used estimated values in the tables listing contaminants of concern in the various media when they exceeded all other reported values for a contaminant in the media under consideration.

D. Physical and Other Hazards

No physical hazards were noted during the site visit.

PATHWAYS ANALYSES

An evaluation of Completed Exposure Pathways and Potential Exposure Pathways was made to determine exposure to contaminants of concern by on-site workers and people living near Olin. Exposure pathways are made up of five elements: source of contamination, environmental media, point of exposure, route of human exposure and receptor population. Exposure pathways are classified as completed, potential or eliminated pathways. Completed pathways are those for which all five elements are present and human exposure to a contaminant or contaminants has occurred in the past or present, or is expected to occur in the future. When one or more of the elements are absent but could exist, then the pathway is characterized as a potential exposure pathway. When one or more elements are missing and never has been and never will be present, then that pathway is eliminated from further consideration. Only the pathways that are significant and relevant to Olin are discussed in detail.

A. Completed Exposure Pathways

Domestic Well Water Pathway

Contaminated off-site domestic water wells are a medium and point of exposure for past, present and future exposures (Table 7, Appendix C). We have not been able to determine the origin of the contamination in the Alluvial Aquifer from which domestic wells draw water. It may be a result of transport of contaminants off-site from the groundwater beneath Olin. The county averages 65.8 inches of rain per year[6] and is subject to violent, heavy rainfalls. Flooding of low-lying areas, creeks, lakes and the Tombigbee River is not uncommon. The heavy rainfall may be a factor in contamination of the water table.

Four active domestic wells have levels of specific contaminants above the ATSDR comparison values (Figure 7, Appendix A). Exposure occurs through ingestion of well water, and through inhalation and dermal exposure. Inhalation exposure may occur when showering if the water is hot enough to volatilize chloroform in the water. One of the chloroform contaminated wells and the mercury contaminated well are southeast of Olin. The other two wells with detectable contamination are southwest of Olin. We cannot state positively that Olin is the source of domestic well water contamination. However, the wells are in a direction of groundwater flow consistent with contamination from the two plumes in the

Alluvial Aquifer. When discovered, one plume was moving west-southwest and the other was traveling east-southeast.

Based on results from the well survey,[5] at least 20 people using the chloroform contaminated wells are likely to be exposed to chloroform levels of 8-13 ppb. The well in which mercury was detected at 0.37 ppb is about 3000 feet southeast of Olin. The well serves one family. Water from the well is used for household purposes, but not for drinking; the family gets city water from a neighbor's house. However, exposure may have occurred in the past. The well contaminated with 1,1,2,2-tetrachloroethane (0.3J) serves about 5 people.

Only active domestic wells were sampled. However, wells that are presently inactive may be opened and used in the future, and the level of contamination in these wells is unknown.

Fish Pathway

Ingestion of fish from the basin on the OU-2 area is a past, present and future completed exposure pathway (Table 7, Appendix C). The basin becomes contiguous with the Tombigbee River during the flood season, about 4-6 months of each year.[1] During this time, fishers can enter the basin from the river by boat. The basin can be entered on foot, also.

In January 1993, Olin consultants conducted a survey of fishing camp residents and people living south of the site to learn how many people fish in the basin. Sixty-one people were surveyed. Of these, 14 persons reported fishing in the basin, at least occasionally. Respondents also were asked how often they eat locally caught fish. Among the 14 people who fish in the basin, two people eat locally caught (not necessarily from the basin) fish every day, six eat fish weekly, and the remaining six people eat fish once a month or less.[1]

An earlier study of local fishing and fish consumption patterns was conducted in 1991 as part of the domestic well water survey.[5] The researchers asked 37 people about their fishing habits and frequency of consumption. According to the survey, 5 people eat fish daily and 9 eat fish weekly. Eighteen people eat fish less than once per week. Information on consumption was missing for 5 people surveyed. It is probable that household members of the fishers eat fish at the same frequency rates. If so, the actual numbers of consumers of locally caught fish are much higher than the rates reported here.

B. Potential Pathways

Soil Pathway

Surface soil contaminants for Olin are largely unknown. Particulates from airborne emissions may be deposited on soil both on-site and off-site. No samples were taken in the 0 to 6 inch soil zone except in the Well Sand Residue feature. The sample was analyzed for mercury only. No data exists for off-site surface soil. Because of these factors and because

concentrations of some substances in subsurface soils are well above comparison values, we have classified surface soils as a potential exposure pathway.

Olin workers are the population most likely to be exposed through incidental inhalation, ingestion or dermal contact to on-site features in the active plant area. The lack of data on OU-2 soils and off-site surface soil, however, makes it impossible to rule out potential exposure to trespassers or area residents.

Sediment Pathway

Sediments in the OU-2 area are a potential exposure pathway for Olin workers and trespassers. We have classified the sediment exposure pathway as potential rather than completed because we have no evidence that actual exposure is occurring or has occurred. Exposure to inundated sediments is unlikely, but we can not rule out the possibility of exposure to unsubmerged sediments.

Samples were taken from flooded sediments and from exposed soils on the floodplain. Several contaminants have concentrations above ATSDR's comparison values for children, but below those for adults. Younger children are unlikely to be exposed to these contaminants. However, older children may trespass in the basin area and be exposed to shallow, unsubmerged sediments through ingestion of soil particles.

Ambient Air

No data are available on ambient air quality. It is possible that exposures may have occurred in the past if not in the present. However, owing to a lack of data, it is impossible to assess the possibility of air exposures either on-site or off-site.

C. Eliminated Pathways

On-Site Groundwater Pathway

No present exposure to contaminated groundwater exists other than some exposure through domestic water wells. Domestic water wells are a completed exposure pathway and are discussed in that section. We have no evidence for past exposure, but future exposure is unlikely because the contamination in the underlying aquifers is confined to the site. No known on-site exposure is occurring at present except for possible exposure to the Olin worker who conducts groundwater sampling. The worker wears protective equipment, making exposure unlikely. Olin obtains potable water from Ciba-Geigy, therefore no exposure is occurring among other Olin workers. The on-site corrective action wells appear to be insuring that no future off-site contamination will occur. There are no restrictions on domestic well use in the area. Thus, exposure could occur if contaminants migrate off-site.

Surface Water

It is doubtful that surface water is, has been, or will be a significant exposure pathway. Concentrations of volatile and semi-volatile organic compounds were low, and it is unlikely that air contamination through volatilization of the compounds will cause adverse health effects. Some metals were found at levels above ATSDR comparison values. However, ingestion of surface water will occur only in unusual and rare circumstances, and the amounts ingested would necessarily be small. Swimming in the basin has not been reported. If swimming does occur, the surface water pathway will need to be reassessed.

Subsurface Soil Pathway

We do not believe that subsurface soil is or has been a significant exposure pathway. On-site features have been capped to prevent worker exposure. Future exposure of workers to subsurface soil is unlikely unless the soil is disturbed. This position may need to be re-evaluated, however, in the event of on-site soil disturbance.

PUBLIC HEALTH IMPLICATIONS

This section will discuss the health effects of site contaminants on the people exposed, evaluate health outcome data, and address questions and concerns raised by the community.

A. Toxicological Evaluation

ATSDR has developed Minimal Risk Levels (MRLs) for contaminants commonly found at hazardous waste sites. An MRL is an estimate of daily human exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. MRLs were developed for ingestion and inhalation exposure routes, and take length of exposure into account. Length of exposure is divided into acute (less than 14 days of exposure), intermediate (15 to 364 days) and chronic (365 days or more).

If an MRL is not available for a specific contaminant, ATSDR uses the EPA's Reference Dose (RfD). An RfD is an estimate of a lifetime daily human exposure to a contaminant, below which no non-cancer health effects are likely to occur.

We have made certain assumptions in calculating estimated exposure doses. The calculations are based on an assumed weight of 70 kilograms (154 pounds) for an adult, and 10 kilograms (27 pounds) for a child. The standard water ingestion rate used is 2 liters per day for adults and 1 liter per day for children. We assumed that adults ingest 50-100 milligrams of soil each day (mg/day) through inhalation of soil particles in the air, and from incidental ingestion of soil particles on hands placed in the mouth. Because of their tendency to place objects in their mouths, small children are assumed to ingest 200 mg/day of soil. For purposes of this report, we used the maximum possible exposure duration of 40 years (1953-1993) for adults

to obtain the most conservative estimate of risk. Exposure durations of one year and 10 years were used in calculations to estimate the risk of non-cancerous health effects to children. Calculations for a child weighing 35 kg and ingesting half the adult dose resulted in exposure doses the same as those for a 70 kg adult. Cancer risks calculated using a 10 year exposure duration were intermediate between those for 1 year and 40 years exposures. Because risks for adverse health effects are greatest for infants and adults with the longest exposure duration, only calculations pertaining to these groups are presented here. No standards have been set to calculate risk of exposure to unborn children; therefore, no risk estimates were made.

Calculations of risk from exposure to contaminated fish were based on the average weights noted above, and on amount and frequency of consumption. We used a consumption rate of 200 grams of fish per meal for an adult to calculate the risks associated with exposure to chemicals at the levels detected. Two hundred grams are slightly more than 7 ounces. We estimated that children would consume 50 grams per meal. Because of difficulties involved in accessing the basin, and taking into consideration the fishing survey data,[1] we estimated risks based on biweekly consumption of fish from the basin. According to the fish survey,[1] at least one person fishes in the basin on a weekly basis. Other respondents reported fishing once per month or less.

One limitation of these calculations must be stressed; it is unlikely that all the fish consumed by a person will come from the basin. Therefore, estimates of exposure to contaminants in fish are conservative and may be an over-estimation of actual exposure. A conservative estimate was used because fish caught in the basin may be frozen for later consumption, extending the number of meals for which basin fish would be available. Also, some people reported daily fish consumption. If the people who reported daily fish consumption eat more than one biweekly meal of basin caught fish, actual exposure may have been under-estimated in some cases.

The estimated doses are compared to health guidelines and reports in the scientific literature to determine if health effects are likely to result from exposure at the levels detected.

Only those contaminants found in completed and potential exposure pathways above comparison levels, or for which no comparison values are available, will be discussed in this section. Each contaminant will be discussed in terms of the population effected, the routes of exposure, and acute or chronic health effects, if any, that may result from the exposure. Any increased risk of cancer to the exposed populations will be discussed.

Contaminants of Concern in Completed Exposure Pathways

Chloroform

Chloroform, also called trichloromethane, is a colorless liquid with a pleasant, nonirritating odor and a slight, sweet taste. Most chloroform in the environment comes from industry.

Small amounts of chloroform are formed as a byproduct of treating drinking water to make it safe. Chlorine is added to most drinking water and many waste waters to kill bacteria. Because of the many ways in which chloroform can enter the environment, small amounts of it can be found almost everywhere.[9]

The members of 2 households near Olin may have past exposure to chloroform from contaminated domestic wells. Members of 1 household presently are being exposed. The exposure is through ingestion, inhalation and dermal absorption routes. However, given the levels of chloroform detected, it is unlikely that adverse health effects will occur from this exposure. Neither of the 2 domestic wells with chloroform contamination had levels above the range normally expected in chlorine treated drinking water (2-44 ppb).[9] The estimated daily dose of chloroform for members of the exposed household is below the ATSDR Minimal Risk Level (MRL) for acute or chronic exposure, and so should not cause non-carcinogenic health effects.

Chloroform has been shown to cause liver and kidney cancer in animals but the evidence that it causes these cancers in humans is inadequate or weak. Chronic human exposure for 40 years may lead to a slight increase in the risk of colon and urinary bladder cancer.[9] The risk is estimated to be one additional cancer death for each one million persons exposed for 40 years to 13 ppb of chloroform in drinking water. Individual exposures of shorter duration or for individuals with lower water consumption rates will result in less risk of developing cancer through exposure to chloroform in drinking water.

Chloroform can be absorbed through the skin when showering with contaminated water. It may be inhaled into the lungs if the water is hot enough to cause the chemical to evaporate.[9] Because the highest level of chloroform found in the domestic wells is within the low end of the range for normal drinking water levels, and also, that exposure through the lungs or skin would be much less than that from drinking the water, the risks involved in exposure through these routes are expected to be exceedingly small. Therefore, we considered it unnecessary to calculate cancer risk resulting from inhalation or dermal exposure.

1,1,2,2-Tetrachloroethane

1,1,2,2-Tetrachloroethane is a colorless, dense, artificial liquid. It has a sweet, penetrating, chloroform-like odor. 1,1,2,2-tetrachloroethane is used to produce other chemicals and as an industrial solvent. It is used to separate other substances, to clean and degrease metals, and in paints and pesticides.[10]

One household has past, present and possibly future exposure to 1,1,2,2-tetrachloroethane through a water supply from a contaminated well. The well served five people at the time of the 1989 well survey.[5] Exposure results through eating and drinking foods and beverages prepared with the contaminated well water.

Information on the effects of human exposure to 1,1,2,2-tetrachloroethane is limited. There have been reports of suicides from drinking this chemical, but the reported amounts have been large (285 mg/kg and above). No ATSDR MRL nor EPA RfD has been reported for 1,1,2,2-tetrachloroethane. The observed level is below the level for drinking water guidelines in several states.[10] Given the small estimated daily dose, it is unlikely that non-cancerous health effects will result from exposure to this chemical.

1,1,1,2-Tetrachloroethane is classified as a possible human carcinogen by EPA. The classification is based on limited animal evidence, and weak or inadequate human evidence. Some studies show that 1,1,1,2-tetrachloroethane can induce pulmonary and liver tumors in mice and rats.[10] Chronic daily exposure for 40 years should lead to no increased cancer risk. The risk is estimated to be one additional cancer case for each one million people exposed for 40 years to the detected level of 1,1,2,2-tetrachloroethane in the drinking water. The risk would be less for individuals with exposure for shorter periods or for those who drink less water from the contaminated well.

DDD, DDE, DDT

DDT is a white, crystalline, tasteless and nearly odorless solid. Once it was a widely used chemical for controlling agricultural insects, disease carrying insects and other pests. DDT use is now prohibited in the United States except in cases of public health emergency. The chemical does not occur naturally in the environment.[11]

DDD and DDE are breakdown products of DDT. To get at total DDT exposure, the amounts given in Table 6 (Appendix B) for DDT, DDD and DDE were summed, and the total was used in risk analysis calculations. The route of exposure to DDT and its breakdown products at Olin is through eating contaminated fish from the basin. The estimated child and adult doses for DDT from bass and catfish are higher than ATSDR's acute MRL. ATSDR has not derived a chronic MRL for DDT since the most sensitive non-cancer effects have been seen at higher doses than the most sensitive acute and intermediate duration effects.[11] The estimated dose for a child is 14 times greater than the MRL. However, as a safety factor, the MRL for DDT is set 1000 times lower than the lowest level at which adverse health effects have been observed. Given the conservative values used in calculating the estimated doses, combined with the safety factor built into the MRL, we do not expect adverse health effects to occur from limited consumption.

Health risks associated with DDT exposure include central nervous system and genotoxic effects. Symptoms of nervous system disorders in humans are hyperexcitability, tremors and convulsions. Similar symptoms have been found in animal studies following acute and chronic exposures. Behavioral deficients in learning have been found in adult mice exposed to DDT before birth. Other animal studies have found developmental and reproductive effects associated with DDT exposure. Several studies suggest that DDT exposure may cause chromosome damage in humans. Chromosomes are structures in cells that carry genetic

information. Animal studies support the evidence for chromosomal abnormalities associated with DDT exposure.[11]

DDT and its breakdown products may increase the risk of cancer in exposed populations. The EPA has classified DDT as a probable human carcinogen. A probable human carcinogen is one for which there is good evidence of carcinogenesis based on animal studies, but for which the human evidence is weak or inadequate. The increased cancer risk from DDT at the levels found at Olin is calculated to be approximately four additional cancer deaths for each 10,000 people who eat one meal of seven ounces of basin fish every other week for 40 years. People who eat fish less frequently should be at lower risk. Conversely, people who eat basin more frequently will be at greater risk.

Hexachlorobenzene

Hexachlorobenzene is a white, crystalline solid. It does not occur naturally in the environment. Hexachlorobenzene is formed as a by-product of the manufacture of other chemicals, including pesticides.[12] Hexachlorobenzene has been found in fish taken from the basin. Consumption of fish from the basin is a past, present and future completed exposure pathway to hexachlorobenzene. However, the estimated dose is less than ATSDR's chronic MRL. No effects of exposure at this level have been found in human or animal studies.[12] Therefore, exposure to these levels of hexachlorobenzene is unlikely to cause adverse, noncancerous health effects.

EPA classifies hexachlorobenzene as a probable human carcinogen. Eating fish contaminated with hexachlorobenzene may lead to an increased risk of cancer. Consuming 200 grams of fish from the basin every other week for 40 years may result in an additional 3.5 cancer deaths for each 100,000 people exposed.

Mercury

Mercury is a naturally occurring substance that has several chemical forms. Metallic mercury is a shiny, silvery, odorless liquid with a metallic taste. Mercury can combine with other elements to form mercury compounds. Organic mercuries result when mercury is combined with carbon. Inorganic forms result when carbon is not part of the compound. Mercury compounds are usually white powders or crystals. All forms of mercury are poisonous, and stay in the environment for a long time. Once mercury enters the environment, natural processes can change it from one form to another. Methylmercury is created from organic mercury by these processes. Methylmercury is of special concern because it can accumulate in some fish, primarily bottom feeders or carnivorous species.

Mercury was detected in one domestic well, but the estimated dose was below both the acute MRL and the chronic oral RfD set by EPA. It is our judgement that mercury contamination in domestic well water is not a health concern at this time.

Most of the mercury that accumulates in fish is mercury that has converted into methylmercury.[13] Some residents near Olin have been and are continuing to be exposed to mercury and methylmercury through ingestion of contaminated fish. Surveys of fishers in this population [1, 5] show that the rate of fish consumption varies from daily to never. The estimated dose for children and adults who eat fish from the basin exceeds the ATSDR's acute MRL for ingestion of organic mercury. The MRL for mercury is set 100 times lower than the dose at which no adverse effects have been found. Because of this, and because of the conservative assumptions used in calculating the exposure dose, we do not anticipate that limited consumption of mercury contaminated fish from the basin will result in adverse health effects.

When a chronic MRL is not available, ATSDR refers to the EPA's chronic oral reference dose (RfD). The RfD is an estimate of daily human lifetime exposure to a contaminant at a level below which non-cancerous health effects are unlikely to occur. The estimated child and adult exposure dose for mercury exceeds the EPA RfD. Again, because of the conservative nature of the estimated exposure doses, and the safety factors built into the RfD, we do not believe that adverse health effects are likely to occur with limited fish consumption.

The human tissue systems most likely to be affected by mercury or methylmercury ingestion are the kidneys and the central nervous system. The brains of developing fetuses may be effected, also. Small children exposed to mercury can be effected because of their more sensitive nervous system. Some animal studies have found that low level exposure to mercury may decrease reproductive ability.[13]

Animal studies of organic mercury have shown changes in kidney cells and tissues following intermediate and low dose exposure. Information on the effect of organic mercury on kidneys in humans is limited. One accidental exposure has been reported. The effected person exhibited increased urinary output, increased thirst and albumin in the urine. Neurological (nervous system) symptoms resulting fron. exposure to organic mercury include prickling, tingling sensations in the hands and feet. Other symptoms are impaired hearing, taste, smell and peripheral vision, slurred speech, poor muscle control, weakness, irritability, memory loss, depression and sleeping problems. Fetal exposure to organic mercury can result in severe brain damage including mental retardation, incoordination and inability to move. Milder effects from lower exposure levels may be delayed development, nervous system abnormalities, and brain-motor retardation. [13]

Some evidence exists for an association between inorganic mercury and leukemia in humans. A study of rats found a link between long term exposure to mercury chloride and tumor formation in male rats. No association has been reported between organic mercury and cancer.[13]

Contaminants of Concern in Potential Exposure Pathways

Shallow soil, sediments and ambient air are potential exposure pathways for many chemicals. We will discuss each chemical listed in Tables 3 and 4 (Appendix B) that has not been addressed previously. However, because no known exposure is occurring or has occurred through these pathways, health implicatio. s will not be examined in detail.

Arsenic

Arsenic occurs naturally in the environment, usually in combination with other elements. When combined with oxygen, chlorine, and sulfur, it is called inorganic arsenic. Organic arsenic is arsenic combined with carbon and hydrogen. The organic forms of arsenic are usually less harmful than the inorganic varieties. Most organic and inorganic forms are white or colorless powders with no smell or special taste.[14]

Inorganic arsenic is poisonous; large amounts (above 60,000 ppb) can cause death. Long-term oral exposure to inorganic arsenic can lead to darkening of the skin and the development of small corn or wart-like growths on palms of hands, soles of feet and torso. Occasionally, these growths may eventually develop into skin cancer. Arsenic is classified by EPA as a human carcinogen. This means there is enough evidence to say that the chemical causes cancer in humans. Oral intake of arsenic has been associated with increased risk of liver, bladder, kidney, lung and skin cancer.[14]

Arsenic was detected in both Operational Units (OU-1 and OU-2) at Olin. The estimated dose for potentially exposed Olin workers in OU-1 is based on calculations for an exposure of five days per week. No ATSDR MRL is available for arsenic, therefore, we have used the EPA RfD for comparison purposes. The estimated potential dose to Olin workers exceeds the RfD.

The estimated dose of arsenic in sediments in the basin area (OU-2) is based on calculations for a 70 kg adult who ingests 100 mg/day of contaminated soil for 26 week each year. The estimated dose is above the EPA RfD. Since some basin samples were taken from non-submerged areas of the floodplain, the potential exists for workers or trespassers to be exposed to arsenic. We have no evidence that such exposure is occurring or has occurred in the past; thus, we believe that arsenic does not pose a threat to the health of the local population at this time.

Beryllium

Beryllium is a hard, grayish substance that occurs as a chemical component of some rocks, soils and volcanic dust. Beryllium enters the environment because of natural processes and human activities. Most beryllium in the sediments is bound to soil particles and movement deeper into the ground or into the groundwater is unlikely.[15]

Most adverse health effects from beryllium are caused by breathing the substance. No adverse health effects are known to occur from ingestion exposure. Oral exposure has not been found to cause cancer in animals. Furthermore, there are no completed exposure pathways for beryllium. Based on these factors, no human health effects are anticipated.

Lead

Lead is a bluish-gray metal with no characteristic smell or taste. It occurs naturally in small amounts in the earth's crust, but most of the lead in the environment comes from human activities. Lead has many uses. The amount of lead added to gasoline, paints, and other commonly used materials has been cut in recent years because of the harmful effects to humans and animals.[16]

Exposure to lead is especially harmful to fetuses and to children. Unborn children can be exposed to lead through their mothers. Exposure can cause premature births, low birth weights and lowered mental ability in infants. Lead exposure has been shown to stunt growth and reduce intelligence quotient (IQ) scores in young children. In adults, lead exposure may decrease reaction time and perhaps memory function. Lead may cause weakness in fingers, wrists or ankles. Middle-aged men may show an increase in blood pressure with exposure. High levels of exposure to lead can cause severe liver and brain damage to both children and adults. Exposure to high lead levels may cause spontaneous abortion in females and can damage the male reproductive system.[16]

ATSDR has not derived an MRL for lead. The EPA has not determined a RfD because no thresholds have been demonstrated for the most sensitive effects in humans.[16] It is not known if lead causes cancer in humans. Based on animal studies, the EPA has classified lead as a probable human carcinogen.

Lead exposure potentially may occur to trespassers in the basin area, but no completed exposure pathway was found. Therefore, lead exposure from basin sediments is not deemed to be a health concern at this time.

1,3-Dichlorobenzene

1,3-Dichlorobenzene was found in the OU-2 sediments. Although the potential exists for trespasser exposure, we do not have any evidence that exposure has occurred. The highest detected level of 1,3-dichlorobenzene in the basin sediments is an estimated value. Therefore, the potential calculated exposure may or may not be an accurate assessment. There is no toxicological profile for 1,3-dichlorobenzene. No completed exposure pathway was found. Because people in the community have not been exposed, we anticipate no adverse human health effects, at present.

1,4-Dichlorobenzene

1,4-Dichlorobenzene, usually called para-DCB or p-DCB, is a white solid with a sweet taste and strong odor. It is produced by chemical companies to make other products and chemicals. 1,4-Dichlorobenzene is the main ingredient in mothballs. It evaporates easily, and as a result, most 1,4-dichlorobenzene is released into the atmosphere. Most human exposure results from breathing 1,4-dichlorobenzene released into the air.[17]
No ATSDR derived MRL or EPA RfD exists for this chemical, but the estimated potential dose is well below the levels found to cause adverse health effects in human or animal studies.[17] Because the chemical is volatile, it evaporates quickly from surface soils and shallow sediments. Exposure will occur only when disturbance of deep sediments allows trapped 1,4-dichlorobenzene to escape to the surface. Therefore, it is unlikely that inhalation exposure to this substance occurs at the site. If sediments are disturbed, the risk involved in inhalation of 1,4-dichlorobenzene may need to be reevaluated.

1,4-Dichlorobenzene is classified as a possible human carcinogen. The classification is based on animal studies at doses greatly exceeding the estimated dose for trespassers. Therefore, we believe that 1,4-dichlorobenzene in basin sediments does not pose a threat to human health at this time.

B. Health Outcome Data Evaluation

According to the 1991 Alabama Vital Events report,[7] the cancer mortality rate for the total U.S. population for the years 1960-1991 was 203.6 deaths per 100,000 population. The Alabama and the Washington County cancer mortality rates for the same period were 216.9 and 189.9 cancer deaths per 100,000 population, respectively.[7] In 1990, the ADPH examined cancer mortality in McIntosh and Washington County to decide if the populations have increased rates for cancer.[8] Age adjusted mortality rates by race and gender for Washington County showed no increase when compared to the state data. The number of cancer deaths in McIntosh was too small to calculate specific rates for the town. Based on this study, no evidence of an increase in cancer rates was found for the county, although the small number of cancer deaths in McIntosh precluded making a definitive statement about that localized area.

We looked at the available data on infant mortality for Washington County.[7] The 1991 infant mortality rate for the county was 6.5 per 1,000 live births. That rate was well below the state average of 11.2. No data are available for McIntosh. Given the low county infant mortality rate, it is unlikely that infant mortality in the McIntosh area has increased significantly because of exposure to hazardous chemicals in the fish and groundwater pathways. However, because the numbers involved are so small, it probably would be impossible to detect a small increase in the McIntosh area infant mortality rate. Some of the chemicals of concern can cause serious effects in unborn children. There is no evidence that exposure is causing effects in fetuses, but again, a small effect might go undetected.

No data are available for other possible health consequences resulting from exposure to chemicals found in the two completed pathways. Therefore, it is not possible to eliminate the possibility that adverse health effects have resulted from exposure.

C. Community Health Concerns Evaluation

Community health concerns are addressed as follows.

Air Exposure Health Concerns

1. Some McIntosh residents and former plant workers are concerned about air pollution and airborne contaminants that may have caused the breathing and lung problems from which they now suffer. Some citizens believe the area has a higher than normal rate of respiratory problems.

Since there is no data on ambient air quality other than the very limited information from the Toxic Chemical Release Inventory (TRI) system, it is impossible to know if residents' breathing and lung problems are a result of air pollution from Olin. There are no quantitative data available to prove a higher than normal rate of respiratory problems.

2. McIntosh residents are worried that the prevailing winds blow air contaminants downwind from the Olin and Ciba-Geigy plants. Residents have reported instances of corrosion of aluminum doors, windows and propane tanks.

Again, no data are available on off-site ambient air quality. If aluminum materials are being corroded, it is most likely a result of chlorine emissions. Insufficient evidence exists on chlorine emissions to say if they are causing the problem.

Ingestion Exposure Concerns

1. Residents are concerned that fish and wildlife may be contaminated.

Fish in the basin are contaminated with mercury and DDT at levels that may cause adverse health effects if consumed once every two weeks or more often. There are no health data to show if residents who eat fish from the basin are actually suffering ill effects because of DDT, hexachlorobenzene and mercury exposure. Given the limitations of the health outcome data available, it is impossible to rule out the possibility of adverse health effects from such exposure. Mercury exposure from eating contaminated fish may cause permanent damage to the brain, kidneys, and to developing fetuses. The primary symptoms of DDT exposure--hyperexcitability, tremors, convulsions and behavioral learning deficits--are not specific to the chemical. Therefore, DDT related health effects, if occurring, may be misdiagnosed. There is no

evidence that chromosomal damage is occurring because of exposure, but again, no study has been conducted to look at that issue. The exposed population is at an increased risk for cancer. The data for Washington County and McIntosh do not show an increase in cancer rates, but owing to the small numbers involved, it would be difficult to detect a change.

There is no evidence that mercury exposure has caused adverse health problems in the exposed population. No data exist on a local level for exposure related symptoms such as kidney and central nervous system effects. There is no registry of birth defects for Alabama, making it impossible to learn whether mercury exposure has resulted in an increase in brain damage, delayed development, nervous system abnormalities or brain-motor retardation among infants. It is possible that adults, children and fetuses are suffering some negative health effects from exposure to mercury and DDT in fish. To prevent future exposures, the ADPH is advising limited consumption of fish from the basin.

No data exists on other wildlife that commonly are eaten by local residents. Most of the common game animals are herbivores (deer, turkey), thus, bioaccumulation of DDT and mercury at levels high enough to cause an adverse health effect is unlikely. It is our judgement, based on the toxicologic data reviewed, that DDT and mercury exposure from eating local game is unlikely to cause adverse health effects.

2. The possible contamination of vegetable gardens is a concern.

Because of the lack of data on off-site soil contamination and ambient air quality, it is impossible to know if consuming vegetables from home gardens is likely to result in adverse health effects. Further studies are needed to resolve this concern.

3. Several people have concerns about drinking water supplies. Some residents complain about odors in the water. It is unclear if complaints refer to the municipal water supply or to domestic well water.

Four active domestic wells had concentrations of some chemicals at levels higher than established comparison values. Chloroform was found in two wells, and mercury and 1,1,2,2-tetrachloroethane were found in one well each. Odors in the water may possibly be related to chemical contamination. However, the wells need to be tested for bacterial or other biological contaminants that can cause odors in domestic well water. Based on the toxicological data reviewed, it is unlikely that adverse health outcomes will result from exposure to the low levels of contaminants found in the wells. However, if a previously inactive well becomes active, testing should be conducted to ensure that no contaminants are present at levels above water quality standards.

Other Health Concerns

1. Residents have voiced concerns about possible health consequences to children who play in contaminated soil.

The lack of data regarding off-site soil contamination makes it impossible to determine if playing in soil will result in adverse health effects to children. However, several chemicals were found in the basin sediments at estimated doses that may cause health effects. Trespassers in the basin may be exposed to these contaminants.

2. McIntosh residents express concern that the community shows high rates of several diseases, including cancer, diabetes, strokes, and high blood pressure. Other complaints include stomach cramps and stomach problems, diarrhea, low resistance to colds, flu and other diseases, chronic bronchitis and recurring infections. Headaches are commonly mentioned as a health concern. Two people have complained of the loss of sense of smell; one of these has lost her sense of taste as well.

Examination of cancer rates for Washington County does not support an increase in cancer rates for the area as a whole. Since the number of cancer cases is so small, it is impossible to determine if an increase is occurring in McIntosh. However, exposure to DDT and its breakdown products through eating contaminated fish from the basin has occurred and is still occurring. The exposure may increase slightly the risk for cancer among people who eat fish caught in the basin.

It is unlikely that the other health problems mentioned above (diabetes, stroke, high blood pressure, stomach cramps and stomach problems, diarrhea, low resistance to colds, flu and other diseases, chronic bronchitis, recurring infections, and loss of smell and taste) are related to exposure to any of the chemicals found in the completed exposure pathways. Chronic doses of DDT and mercury, the main contaminants of concern, have not been associated with the reported symptoms in either human or animal studies.

3. The local physician reports that several families in the area have members with multiple sclerosis.

There is no known association between exposure to chemical contaminants, particularly DDT and mercury, and multiple sclerosis. Therefore, it is unlikely that chemical contamination from Olin is linked with the cases of multiple sclerosis. The observed rate could be caused by chance or unknown events.

CONCLUSIONS

1. After reviewing the data, we have classified Olin as a public health hazard. The classification is based on evidence that the local population is being exposed through the domestic well water and fish exposure pathways to levels of contaminants that could result in adverse health effects.

2. Area residents trespass on the site, primarily to fish in the basin. There are "No Trespassing" signs posted for the basin, but they are small and easily ignored. People who eat fish caught in the basin are exposed to DDT and mercury at levels that may cause adverse health effects. Exposure to DDT may cause damage to the central nervous system, decreased fertility and chromosome damage.[11] Mercury exposure may cause kidney and central nervous system damage. It can cause brain damage in unborn children.[13]

3. Exposure to DDT, hexachlorobenzene, mercury, chloroform and 1,1,2,2-tetrachloroethane in fish and domestic well water may lead to an increased cancer risk. The evidence, however, is limited and is based primarily on animal studies. In addition, conservative estimates were used to calculate the maximum risk associated with exposure.

4. Trespassers and Olin workers in the basin and ditches potentially may be exposed to contaminated sediments.

5. There is insufficient data to characterize the health risks associated with surface soils (0-3 inches) both on-site and off-site. In addition, it is impossible to address community concerns regarding airborne pollutants because of the lack of data.

6. The lack of local health data prevents making a conclusive determination of the impact that exposures may be having on the health of community residents.

RECOMMENDATIONS

Cease/Reduce Exposure Recommendations

1. Further restrict public access to the basin (OU-2).

2. A fish consumption advisory should be placed on the basin.

3. A survey of basin fish consumption rates is recommended to further define the exposed population. Biological testing is recommended if warranted by the results of the survey. If the survey results and biological testing indicate a need, a voluntary tracking system should be established for local residents.

Site Characterization Recommendations

1. Obtain additional sampling data for on-site and off-site surface soil (0 to 3 inches deep).

    a. Check on-site soil in areas outside the specific features tested in the RI to learn if worker exposure is occurring.

    b. Sample the yards of residences along River Road, directly across from Olin.

2. Sample ambient air quality at the fenceline of the Olin property, particularly in the direction of seasonally prevailing winds.

3. Monitor fish samples from the basin for mercury, methylmercury, DDT, DDD and DDE.

4. Quarterly monitoring should be conducted on the mercury contaminated well, and an alternative water supply should be available for the exposed household if the level exceeds drinking water standards.

Health Activities Recommendation Panel (HARP) Recommendations

The data and information developed in the public health assessment of the Olin Chemicals/McIntosh Plant (Olin) NPL site have been evaluated by the ATSDR Health Activities Recommendation Panel (HARP) for follow-up activities. HARP members concurred with the designation of the site as a Public Health Hazard because of mercury and DDT contamination. The Alabama Department of Public Health currently is developing a health advisory for fish consumption from the basin area of the site. In addition, the panel offers the following recommendation.

> Community health education should be provided to the exposed populations about the possible health effects of eating mercury and DDT contaminated fish from the basin. Particular attention should be given to educating those segments of the population who rely heavily on fishing to supplement their diet, and to special populations such as blacks, the elderly and people living in the fish camp.

PUBLIC HEALTH ACTIONS

The following Public Health Action Plan (PHAP) for the Olin Chemicals/McIntosh Plant site contains a description of actions to be taken by ATSDR and/or ADPH at and in the vicinity of the site subsequent to the completion of the public health assessment. The purpose of the PHAP is to ensure that the public health assessment not only identifies public health hazards, but provides a plan of action designed to mitigate and prevent adverse health effects resulting from exposure to hazardous substances in the environment. The following public health actions will be implemented by ATSDR and/or ADPH.

1. ADPH will evaluate the feasibility of conducting quarterly testing on the mercury contaminated well.

2. ATSDR, in cooperation with ADPH, will evaluate the feasibility of a community education program designed to acquaint the community with the possible health effects from eating mercury and DDT contaminated fish.

3. Educational material regarding possible health effects from consumption of mercury and DDT contaminated fish will be sent by ATSDR through ADPH to the local physician.

4. ADPH will evaluate the feasibility of performing a survey to determine the amount and frequency of consumption of fish from the basin.

5. The ADPH will be available to answer questions from the community pertaining to the site.

6. ATSDR, in cooperation with ADPH, will evaluate the PHAP annually. As new data becomes available, the public health assessment will be updated as necessary.

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ATSDR

CERTIFICATION

This Olin Corporation/Mcintosh Plant Public Health Assessment was prepared by the Alabama Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun.

Richard R. Kauffman, M.S.
Technical Project Officer
Remedial Programs Branch
Division of Health Assessment and Consultation (DHAC)
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment, and concurs with its findings.

Robert C. Williams, P.E., DEE
Director, DHAC, ATSDR

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16. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead. Atlanta: ATSDR, February 1992.

17. Agency for Toxic Substances and Disease Registry. Toxicological profile for 1,4-Dichlorobenzene. Atlanta: ATSDR, February 1992.

APPENDICES

APPENDIX A

Figures

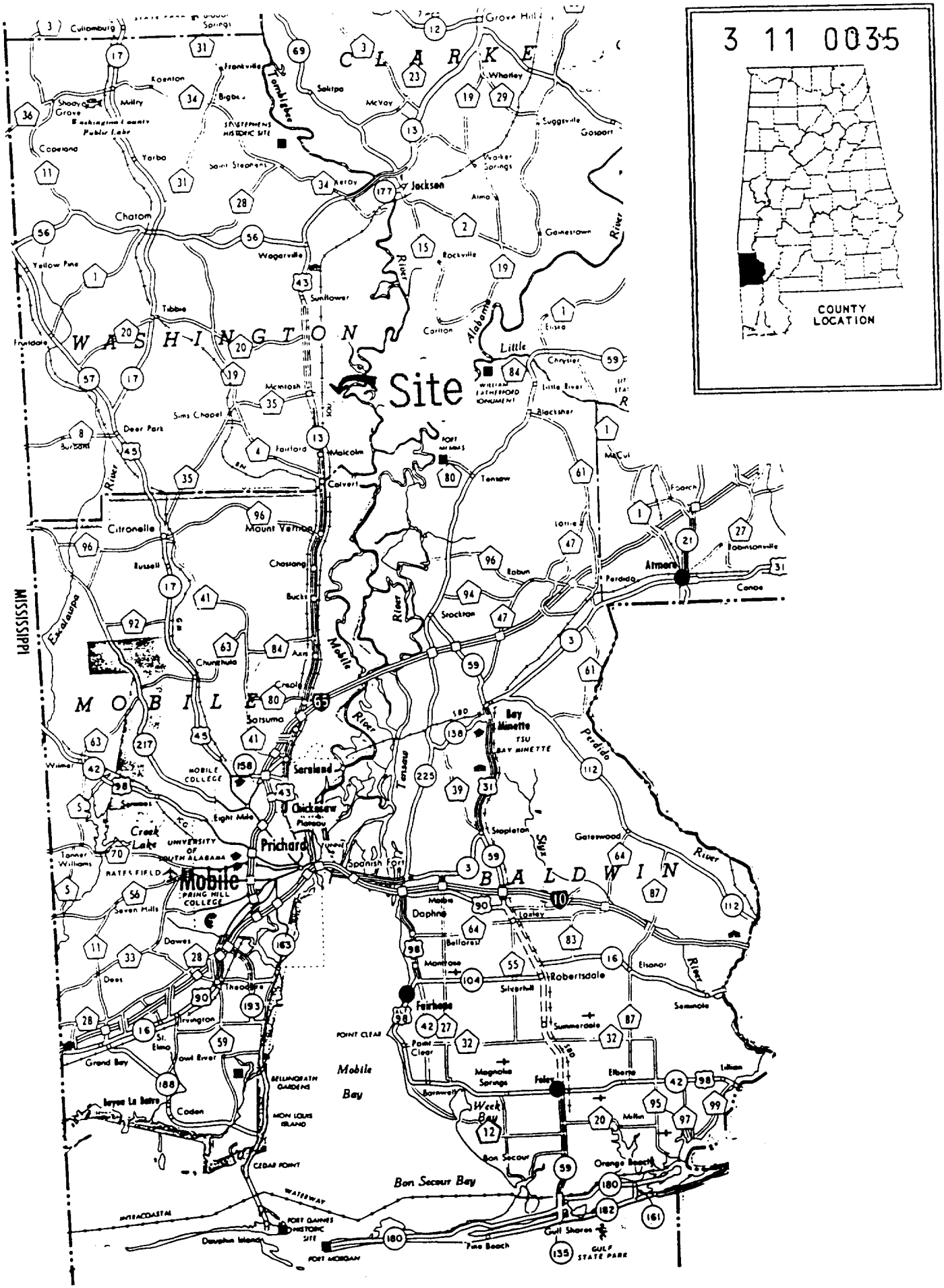
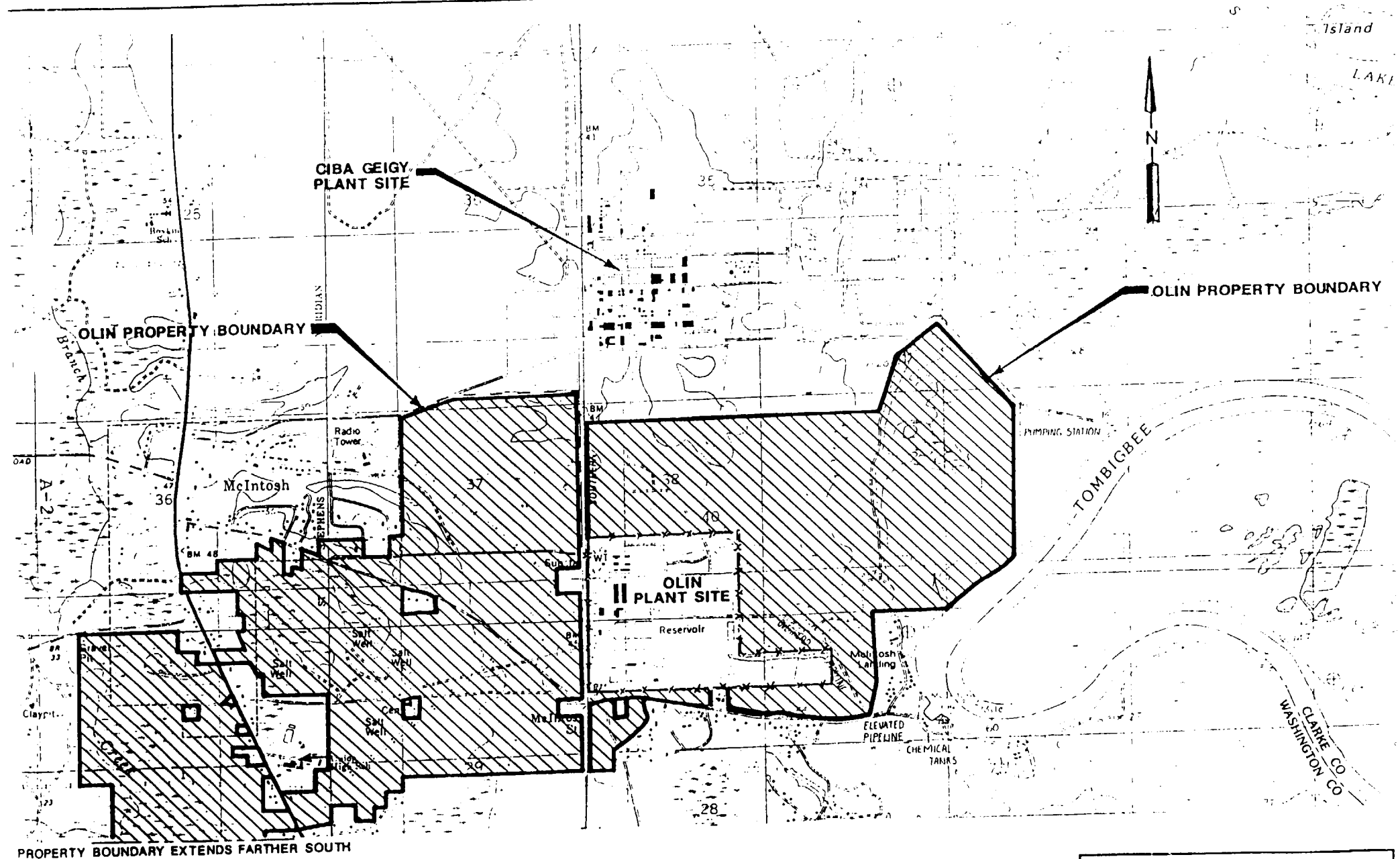


Figure 1
Area Location Map
A-1



LEGEND

—x— OLIN PLANT SITE FENCE LINE

▨ OLIN PROPERTY BEYOND PLANT SITE

Figure 2
Site L tion Map

RI/FS
McINTOSH PLANT SITE

Woodward-Clyde Consultants
Consulting Engineers, Geologists and Environmental Scientists
Baton Rouge, Louisiana

OLIN CHEMICAL CORPORATION
CHARLESTON, NESSEE

MADE BY: SJL	12/90	FILE NO.	90B449C
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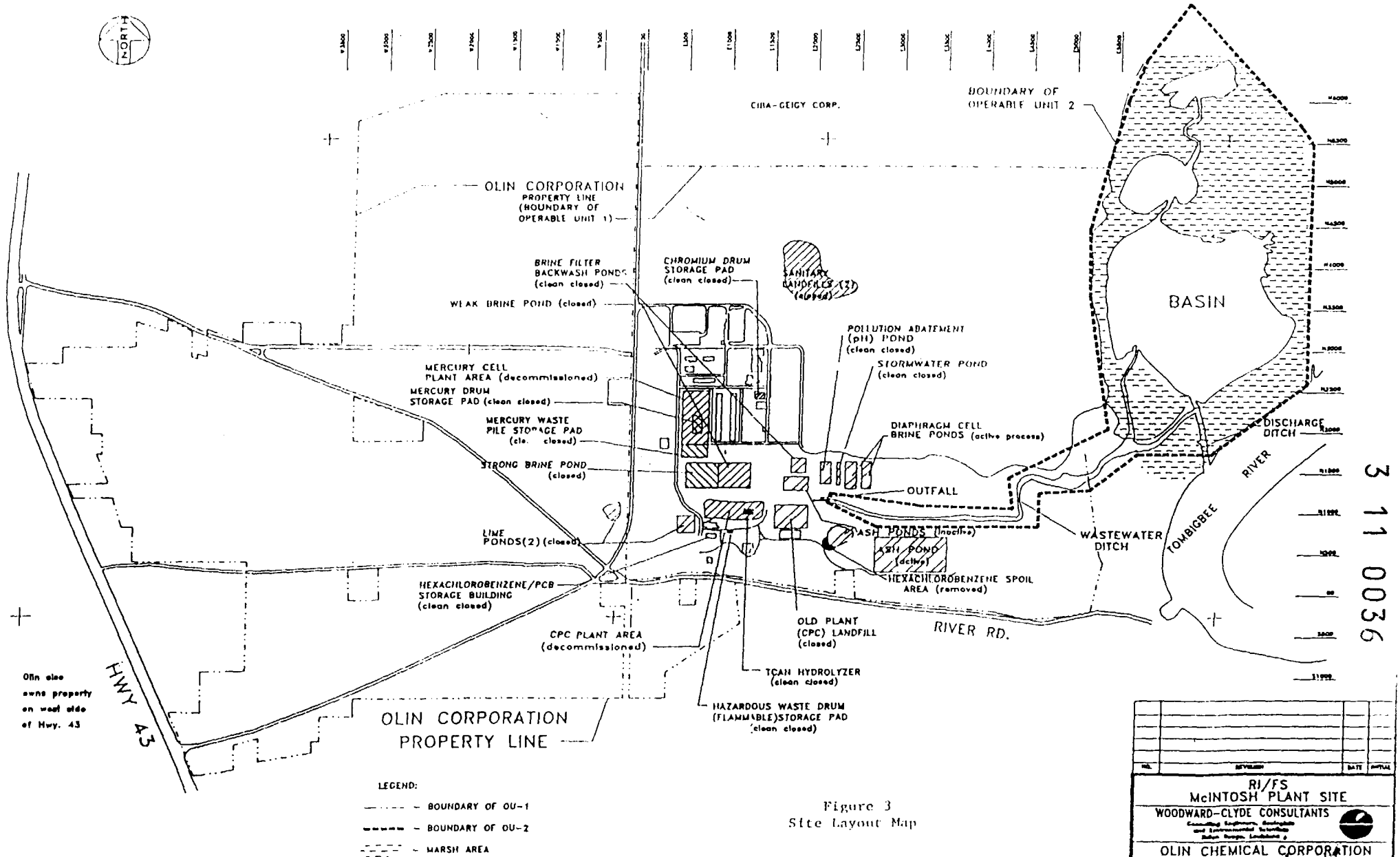

Figure 3
Site Layout Map

RI/FS
McINTOSH PLANT SITE
WOODWARD-CLYDE CONSULTANTS
OLIN CHEMICAL CORPORATION
CHARLESTON, TENNESSEE
DRAWN BY: FT | DATE: 6/11/91 | FILE NO.: 90B449C
CHECKED BY: [illegible] | DATE: 9/16/92

A-3

3 11 0036

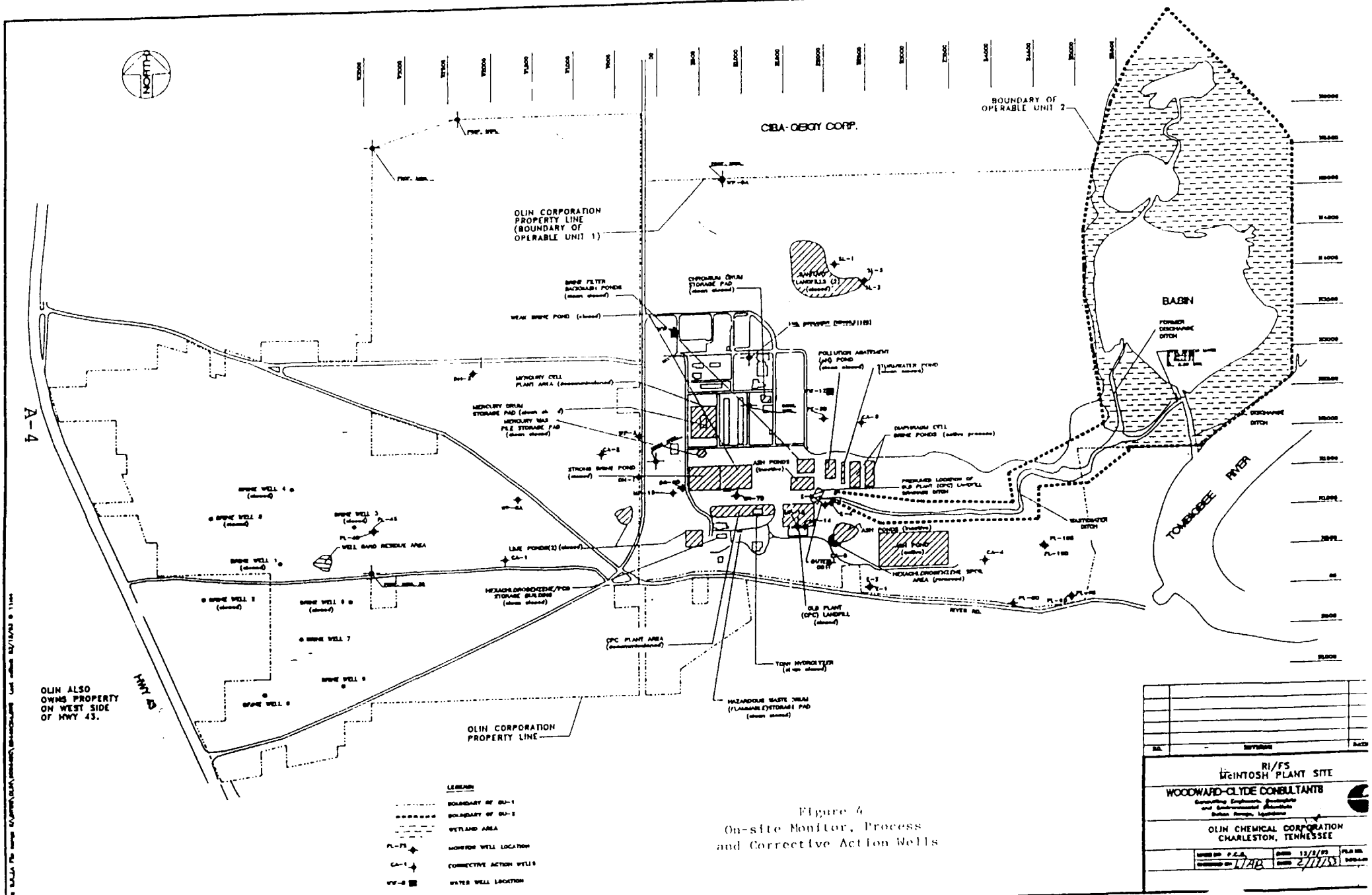

Figure 4
On-site Monitor, Process
and Corrective Action Wells

RI/FS
McINTOSH PLANT SITE
WOODWARD-CLYDE CONSULTANTS
OLIN CHEMICAL CORPORATION
CHARLESTON, TENNESSEE

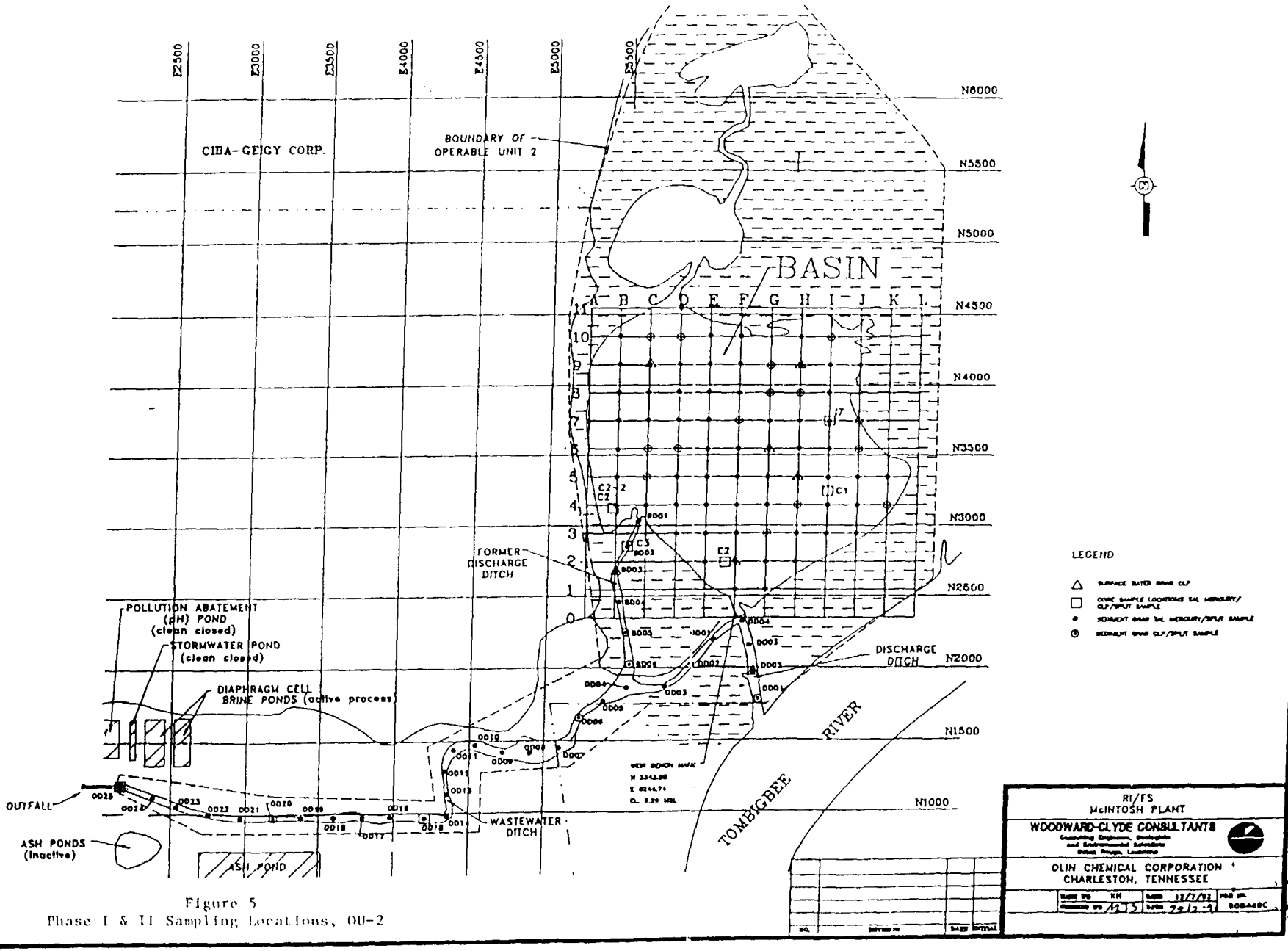

Figure 5
Phase I & II Sampling Locations, OU-2

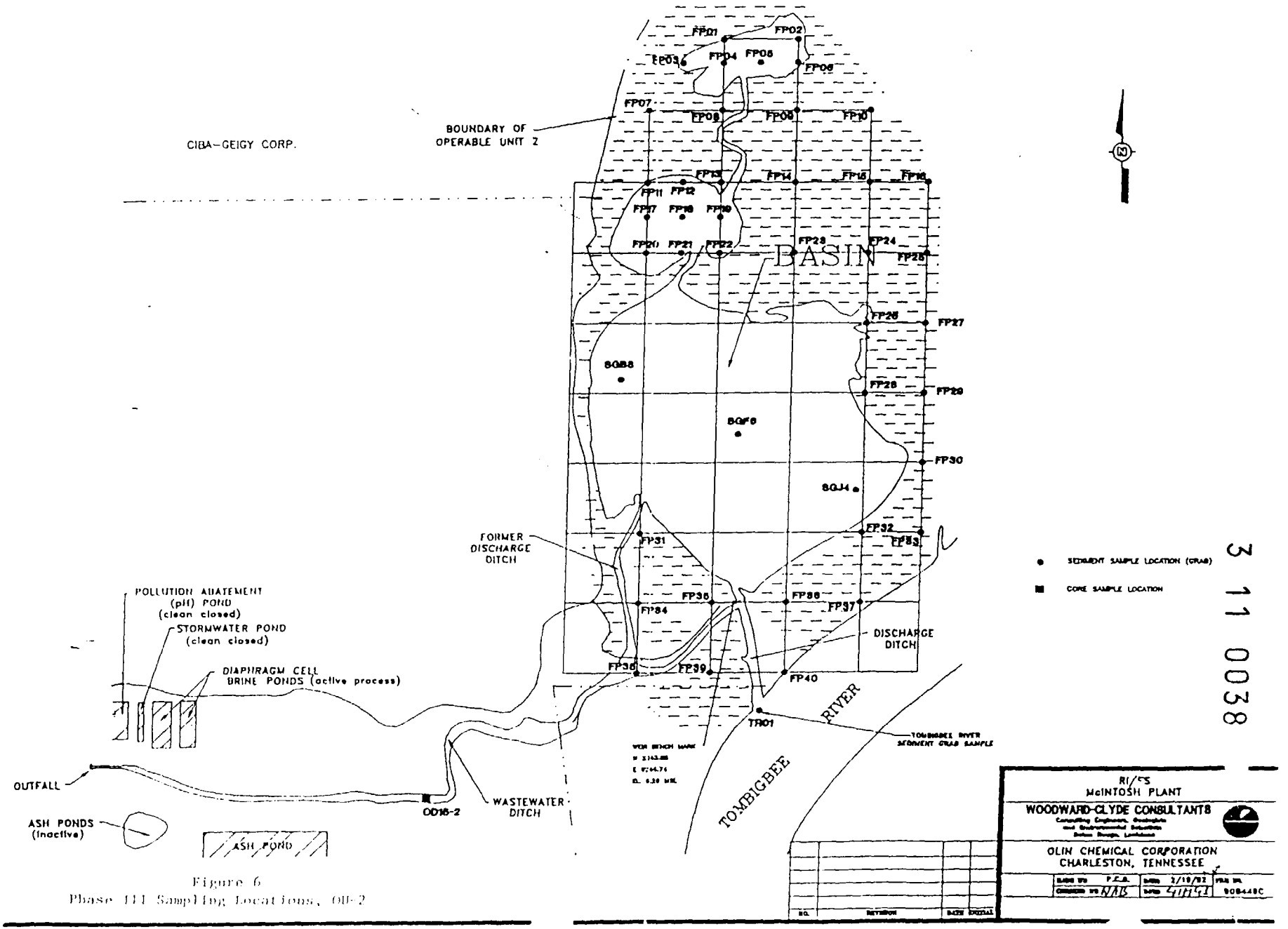

Figure 6
Phase III Sampling Locations, OU-2

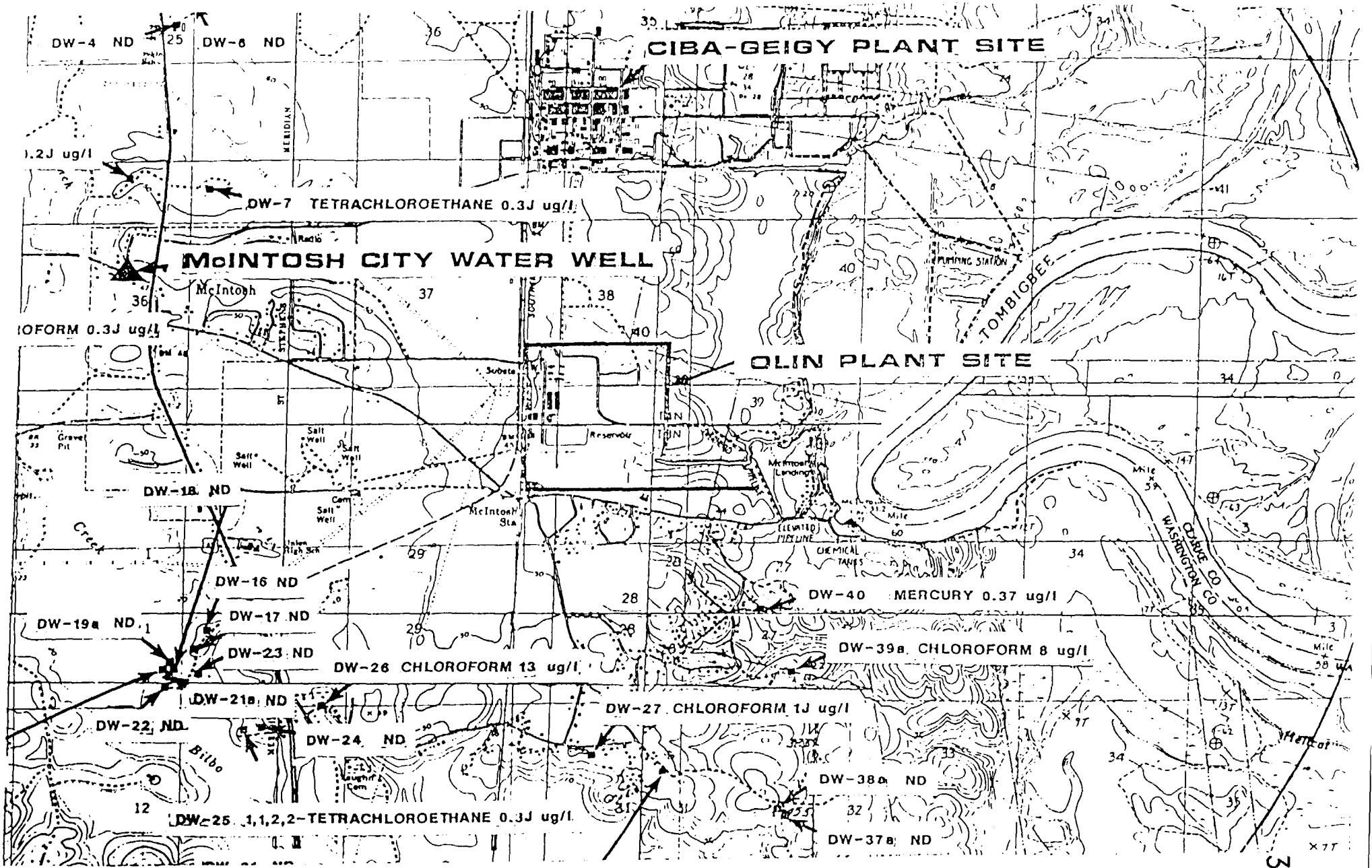

Figure 7
Contaminants of Concern in Domestic Water Wells

APPENDIX B

Contaminants of Concern

Table 1. Maximum Concentrations of Contaminants of Concern in On-Site Groundwater from the Alluvial Aquifer.

Contaminant	Maximum ppb	Date	Reference	Comparison Value	
				ppb	Source
Selected Metals					
Antimony	2120.00 J*	9-91	1	6P	MCL
Arsenic	32.70J	9-91	1	0.02	CREG
Beryllium	115.00J	9-91	1	0.008	CREG
Chromium	719.00	9-91	1	100	MCL
Copper	3430.00J	9-91	1	1300A	MCL
Lead	441.00	9-91	1	15A	MCL
Mercury	146.00	9-91	1	None	
Nickel	1310.00	9-91	1	600P	MCL
Volatile Constituents					
Benzene	350.00	9-91	1	1	CREG
Bromodichloromethane	65.00	9-91	1	0.6	CREG
Bromoform	31.00	9-91	1	4	CREG
2-Butanone (MEK)	200.00J	9-91	1	None	
Carbon tetrachloride	8.00J	9-91	1	0.3	CREG
Chlorobenzene	2500.00	9-91	1	700	RMEG
Chloroform	1200.00	9-91	1	6	CREG
Dibromochloromethane	40.00	9-91	1	0.4	CREG
1,1-Dichloroethane	3.00J	9-91	1	None	
1,1-Dichloroethene	5.00J	9-91	1	0.06	CREG
Semi-Volatile Constituents					
1,2-Dichlorobenzene	4000.00	9-91	1	3000	RMEG
1,4-Dichlorobenzene	4100.00	9-91	1	75	MCL
Pesticides			1		
Alpha-BHC	5.60	9-91	1	0.02**	CREG
Beta-BHC	2.20	9-91	1	0.02**	CREG
Delta-BHC	0.57	9-91	1	0.02**	CREG
Gamma-BHC	1.00	9-91	1	0.02**	CREG
Gamma Chlordane	0.20	9-91	1	0.03	CREG

* -- The metal values reported are for total, not dissolved constituents.
** -- No comparison value is given for this pesticide; the value used is for technical Hexachlorocyclohexane (t-HCH).
P -- Proposed
A -- Action Level for drinking water (EPA)
J -- The associated numerical value is an estimated quantity.

NOTE: Levels for all constituents from the Miocene Aquifer are lower than those reported for the Alluvial Aquifer, therefore, only the maximum values from samples taken from the Alluvial Aquifer are used for comparison to reference values.

Table 2. Maximum Concentrations of Contaminants of Concern in On-Site Surface Water, OU-2.

Contaminant	Maximum ppb	Date	Reference	Comparison Value	
				ppb	Source
Selected Metals					
Arsenic	12.20	8-91	1	0.02	CREG
Chromium	882.00	8-91	1	200	RMEG
Lead	3.80J	8-91	1	None	
Mercury	2.80	8-91	1	None	

J -- The associated numerical value is an estimated quantity.

Table 3. Maximum Concentrations of Contaminants of Concern in On-Site Shallow Soils, OU-1.

Contaminant	Maximum ppm	Date	Reference	Comparison Value	
				ppm	Source
Arsenic	1.40	8-92	1	0.4	CREG
Hexachlorobenzene	5.60	8-12	1	0.4	CREG

Table 4. Maximum Concentrations of Contaminants of Concern in CLP On-Site Sediment, OU-2.

Contaminant	Level ppm	Date	Reference	Comparison Value	
				ppm	Source
Selected Metals					
Arsenic	16.10	8-91	1	0.4	CREG
Beryllium	3.70	8-91	1	0.2	RMEG
Lead	44.20	8-91	1	None	
Semi-volatile Constituents					
1,3-Dichlorobenzene	3.70J	11-91	1	None	
1,4-Dichlorobenzene	0.60	11-91	1	None	
Hexachlorobenzene	1002.00	11-91	1	0.4	CREG
Pesticides			1		
p,p'-Dichlorodiphenyl-dichloroethylene (DDE)	4.00	8-91	1	2	CREG

J -- The associated numerical value is an estimated quantity.

Table 5. Maximum Concentrations of Contaminants of Concern in On-Site Fish Fillets, OU-2.

Contaminant	Maximum mg/kg	Date	Reference
Largemouth Bass			
p,p'-Dichlorodiphenyl-dichloroethane (DDD)	3.80	11-91	1
p,p'-Dichlorodiphenyl-dichloroethylene (DDE)	5.80	11-91	1
p,p'-Dichlorodiphenyl-trichloroethane (DDT)	0.43	11-91	1
Hexachlorobenzene	0.19	11-91	1
Mercury	2.20	11-91	1
Channel Catfish			
p,p'-Dichlorodiphenyl-dichloroethane (DDD)	3.00	11-91	1
p,p'-Dichlorodiphenyl-dichloroethylene (DDE)	5.90	11-91	1
p,p'-Dichlorodiphenyl-trichloroethane (DDT)	0.36	11-91	1
Hexachlorobenzene	0.19	11-91	1
Mercury	2.20	11-91	1

Off-Site Contamination

Table 6. Maximum Concentrations of Contaminants of Concern in Off-Site Domestic Water Wells.

Contaminant	Maximum ppb	Date	Reference	Comparison Value	
				ppb	Source
Chloroform	13.00	11-91	1	6	CREG
Mercury, Inorganic	0.37	11-91	1	2	MCL
1,1,2,2-Tetrachloroethane	0.30	11-91	1	0.2	CREG

APPENDIX C

Exposure Pathway Tables

TABLE 7. COMPLETED EXPOSURE PATHWAYS

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSURE POPULATION	
GROUND WATER	UNKNOWN	GROUNDWATER (PRIVATE WELLS)	RESIDENCES, TAP, PUMP	INGESTION INHALATION DERMAL	RESIDENTS SOUTH, SOUTHWEST OF OLIN	PAST PRESENT FUTURE
FISH	OLIN	FISH	BASIN (OU-2)	INGESTION	PEOPLE WHO EAT FISH CAUGHT IN THE BASIN	PAST PRESENT FUTURE

TABLE 8. POTENTIAL EXPOSURE PATHWAYS

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSURE POPULATION	
SOIL	OLIN	SOIL (0-12')	OU-1 FEATURES	INGESTION INHALATION DERMAL	OLIN WORKERS	FUTURE
AMBIENT AIR	UNKNOWN	AIR	ON-SITE, RESIDENCES NEAR PLANTS	INHALATION	OLIN WORKERS, ADULTS & CHILDREN WHO LIVE DOWNWIND	
SEDIMENT	OLIN	SEDIMENTS	OU-2	INGESTION INHALATION DERMAL	OLIN WORKERS & ADULTS & CHILDREN WHO FISH IN THE	FUTURE

APPENDIX D

Public Comment Period

The Olin Chemicals/McIntosh Plant site public health assessment was available for public comment from December 6, 1993 to January 15, 1994. The public health assessment was available to community residents and other interested parties at the McIntosh Town Hall and the Saraland Public Library. News releases and legal notices announcing the public comment period appeared in local newspapers. The public comment period was intended to give community members and other interested parties an opportunity to voice additional concerns or make comments pertaining to the Olin Chemicals/McIntosh Plant site public health assessment. However, no comments were received by the Alabama Department of Public Health during the comment period.